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INTERNATIONAL TRADE RELATIONS.

We publish in this issue one or two articles bearing on the subject of the international relations of American trade. From Germany come suggestions with regard to the methods of cultivating trade with that country, which in business and manufacturing methods has much likeness with our own, and is as ready to buy as it is to sell, provided prices, quality and packing are right. Of German electrical apparatus and supplies, America has always been a purchaser, and similarly there is a good market in Germany for many of our electrical specialties. The article which we present this week on the lighting of the Atlantic liner the "Deutschland," is, in this connection, unusually interesting from the opportunity it affords to study the best German methods of marine electrical engineering.

Another article likely to provoke thought is that wherein the reply of the United States Bureau of Statistics to the inquiries of Mr. Naoroji is set forth, trying to explain the enormous excess of American exports over imports. This is no longer a "debtor" country, having bought back all of its own securities that can be lured from foreign strong-boxes; but the piling up of an apparent balance in our favor goes on, that once could only have been explained on the theory that it went to wipe out interest charges. An explanation for the fact that the excess seems to remain unliquidated in trade fiscal statements is that our people are not only investing the proceeds of their sales in the securities of foreign governments, but are putting them into foreign industrial properties also.

One other article in this issue also throws a curious side light on international relationships, namely, that on the new hotel at Nassau, Bahamas. A description is given of what is perhaps the finest hotel in a British colony, but it happens to be equipped throughout with American apparatus, to have been designed and constructed by American engineers, and to have been paid for outright by an American millionaire, who is spending his money making other folks comfortable—as good an occupation as giving them books to read. This addition to the resources of the British Empire is one that we can all contemplate with complacency.

EXIT THE CABLE.

Last week the famous cable system on Broadway, New York, made its last haul, and on Monday morning of this week electric conduit trolley cars were in successful operation over the same route. The swiftness of the change, when it actually came, was one of the most surprising things this city has seen, and New Yorkers had not expected to find cars running over the road for a week. But the huge transformation was all effected on a Sunday, and a wet Sunday at that, so that public inconvenience was reduced to a minimum, and public praise of the feat was hearty and warm to an unusual degree. President Vreeland and his associates of the Metropolitan staff have indeed deserved well of their fellow citizens, in the skill, energy and zeal with which they substituted electricity for cable on the best known thoroughfare of the New World.

But we cannot refrain from remarking that the change, as a change, has been a long time coming. It is now just about ten years ago, before the Vreeland regime, we noted that the cable was going in, and entered a protest on the ground that it would soon have to come out and be replaced by electricity. The criticism doubtless

seemed premature to some persons, as they did not hesitate to say so, but facts have abundantly justified our belief that an electric conduit system could have been put in ten years ago, and all the expenditure on the costly cable plant and its abandonment avoided.

To a certain extent, history is repeating itself in the trials now being made with compressed air cars in this city. They are an older story than the cable, and they are an even worse failure; and it does seem to us a great pity that time and money should be wasted in the effort to substitute them for electricity, which is emphatically the all-conquering, all-sufficient agent of modern traction.

WORK OF THE SMITHSONIAN INSTITUTION

Among the notable exhibits at the recent Conversazione of the American Institute of Electrical Engineers were several from the Smithsonian Institution, including a 20-foot map of the solar spectrum constructed in the Astro-Physical laboratory of the Institution. Several bolometers and some aerodrome photographs were also exhibited, and Professor Langley had printed for distribution some hundreds of copies of a description of each exhibit. We learn that this exhibition was made in accordance with a new plan for extending the usefulness of the Smithsonian Institution, which plan was first put into effect at the Institute Conversazione, and that the exhibits shown in New York now form part of a collection that has been sent to the Pan-American Exposition. Professor Langley in thus broadening the scope of the Institution and popularizing its work has made a departure from traditional policy that cannot be too highly commended. While the former policy of the Institution was perhaps the best for the period when it was outlined, the conditions of to-day are such that the scientific world is quite independent of a special agency for the transfusion of knowledge. On the other hand, interest in the higher work of science on the part of others than the savant, is becoming yearly more widespread, and in catering to the popular desire for knowledge of the latest scientific achievements, the Smithsonian Institution will be accomplishing a good work, no small part of which will lie in its tendency toward counteracting the pernicious influence of sensational newspaper science.

ATOMIC FRAGMENTS.

In a letter to the New York *Sun* of May 15, Professor Hall, of Harvard, discusses the recent atomic theory of Professor J. J. Thomson, according to which an atom belies its name and is composed of a great number—perhaps 1000—smaller quantities provisionally called corpuscles. Each corpuscle when separated from the atom to which it belongs carries a definite negative charge, or constitutes a negative ion. It seems that the atom, a hypothetical minimum quantity of matter, was worked too hard, and broke down in the attempt to execute all its duties. According to the new theory, we have room for orbits and a large interplanetary system, all confined within the limits of a single atom; and although the corpuscles of which atoms are composed are all alike, or indistinguishable from one another, the particular mode of aggregation, configuration or orbital motion of these corpuscles differentiates the atoms of one elementary substance from those of another, or differentiates substances. Professor Hall shows that while there is ample room in the new hypothesis for a great variety of new theories of fundamental matter, yet our pristine and erstwhile revered notions concerning the indivisibility of atoms are probably destroyed beyond all chance of repair. Let us hope that the new internal complexity will make amends to our shattered idol for the loss of its prestige as being "one and indivisible."

THE UTILITY OF LIBRARIES.

The interesting letter which we publish this week from Dr. Park Benjamin on the subject of the gift by Dr. S. S. Wheeler to the Institute of the Latimer Clark library, suggests one or two lines of thought. We do not understand the writer to decry libraries, he being himself a discriminating and successful collector. Nor does he find it a matter of regret that this collection should be taken out of the stout packing cases in which it has been immured, and is made part of the possessions of the Institute. The contention seems to be that such gifts are not fully appreciated, and that this particular one is little likely to be used.

Dr. Benjamin cites his own experience, when, being in possession of a fine collection of the earliest electrical and philosophical literature, he threw it open to the public, and, then, discovering the absolute indifference of people, generously, with one or two friends, turned it over to the Naval Academy at Annapolis. We cannot see that the books are very happily placed at Annapolis, but they are at least preserved as a valuable collection, even though the students look at them as little as did the public of New York.

The main point about a library is its availability, and we cannot quite agree with Dr. Benjamin that his library was available in the broad sense that the Wheeler gift will be. Very few people care to intrude on a man's privacy to consult his books, and every one going to Dr. Benjamin's office knew they must be disturbing the practice of a busy professional man, to say nothing of being disturbed themselves by hearings and the movement of clients. In the same way, there are private collections of pictures in this city open to the publiv on very easy terms of admission. Who ever goes to them? How many of our readers, visitors of the Metropolitan Museum, have ever seen the private Vanderbilt collection or that of Mr. Jacob Schiff? The reticence or delicacy of the cultured men and women desirous of studying books and pictures in private collections is the very bar to their doing so. In Europe, there is decidedly less reluctance in inspecting such possessions in a private house, but an American finds it get on his nerves to do so.

In connection with the Wheeler gift, which we are confident will be used very liberally, when installed in this city, there are two points to be made. One of them is that it is not simply a collection of rare books, in which necessarily few are interested as students, but is rich in engineering files and volumes, and is a "working library" of unusual merit. Moreover, it will have annexed to it all the files of the Institute of current publications, already freely used, and, best of all, it will have a most careful and elaborate catalogue, in which each important book will be noted in detail. Every member of the Institute will have a copy of that catalogue, and we shall be greatly surprised if that does not help to stimulate that refined taste for historical-scientific research, which Dr. Benjamin himself has so conspicuously illustrated as a collector and author.

TECHNICAL EDUCATION.

Our issue of May 11 contains an interesting letter, in which the writer, taking as a text a recent address by Dr. Pritchett, president of the Massachusetts Institute of Technology, discusses the subject of technical education in its general educational aspect—that is, the value of such an education in qualifying a young man not only for merely technical positions, but also to take advantage, with good prospect of success, of opportunities that may offer in the administrative and commercial branches of the industry with which he connects himself. In his address Dr. Pritchett points to the new factors which have entered into modern commercial and industrial life, and concludes that under modern conditions the duties of the manufacturer, the man who directs export trade and the man in railway administration, are rapidly becoming those of a profession and not those of a business. For this profession he considers there is a training to be

had in the schools which will not only save time for the individual, but which will develop a broader, a more efficient and a higher type of man—a training which shall not only bring a keener vision, but a wider outlook and a better perspective. Allusion is made to the significant fact that the man who prepares the raw material into the manufactured product is now almost always of college training, but that 40 years ago it was considered just as impossible to train an engineer in the schools, as to-day it is thought impossible to train the man who directs railroads or banks or export trade or manufacture.

Mr. Nostrand in his communication does not disagree entirely with the views of Dr. Pritchett, but confining consideration to the education afforded by the technical schools of to-day, he believes that the methods of many of these will have to be revolutionized before their graduates can be considered to possess the qualifications necessary to success in the broader walks of life to which Dr. Pritchett refers; that many of the present courses conduce to narrowness of vision rather than to the breadth of view which is so necessary in those who have to do with the relations of men to each other. While Mr. Nostrand by no means considers systematic education a bar to eminent success in the business world, yet he makes use of an illustration which usually forms the entire argument of those who sneer at college education, namely, that the most successful men of to-day lack entirely that accomplishment. This much-quoted illustration loses almost all of its force when we consider that the success of these men is rooted in the conditions of 30 or 40 years ago—in a period when a college education had for its object the fitting of young men for the so-called "learned" professions, or imparting to the sons of the wealthy or well-to-do the traditional academic culture having no direct utilitarian object. Through his education out of sympathy with the industrial and commercial spirit, and viewed askance by all men of affairs, had the college man of that period aimed at industrial leadership he would have labored under a handicap much harder to overcome than the lack of education on the part of the man mounting from the foot of the ladder. To-day the conditions are quite different. The value of systematic mental training is now almost universally recognized, and in many of our greatest industrial establishments, the rungs of the ladder leading to higher things are now almost exclusively reserved for the man of college or equivalent education.

It cannot be denied, however, that the criticism of Mr. Nostrand would have considerable force were it admitted that the present organization of technical education is such as to conduce to narrowness rather than breadth of mental vision, thereby tending to limit in after life the opportunities of the graduate to those arising in purely technical departments; and it must be acknowledged that such an admission cannot be avoided in the case of some of our technical schools. Where it does apply, however, we believe the underlying cause is not difficult to discover, and that when revealed it will not be found an evil inseparable from technical education. Were the instruction in technical courses confined to the inculcation of principles, to teaching the various branches of science so that each shall stand out in the mind of the student in its full proportions and in proper perspective and relation to other branches, we believe the reproach that technical education narrows the mind, would lose the greater part of its force. Where, however, technical instruction consists largely in fitting the student so that he may, upon graduation, have an immediate wage-earning capacity, the reproach is apt to hold, particularly if so-called "practical work" is made a prominent feature of the course, which is quite likely in such a case. Indeed, we believe the worst evil of present technical education is that arising from too great stress being laid on practical work. At the present time graduates from technical schools are coming more and more to be considered merely as raw material for engineers, and, as a rule, they can obtain no responsible position with the larger electrical companies until after having served a period in a shop-student course at merely nominal pay. In view of this condition, which, in a sense, may be considered to reflect the opinion of manufacturers as to the value of the so-called practical knowledge imparted in the schools, the inutility is manifest of sacrificing the study of principles—which sacrifice, as a rule, can never be compensated for in after life—to practical work of any kind that does not have an educational value comparable in permanent effect to that obtainable in the lecture and study room.

That the broader technical education here referred to is beginning to be appreciated at its true value is indicated by the trend of thought shown in the recent volumes of *Proceedings* of the Society for the Promotion of Engineering Education, and elsewhere in papers by educators. Whether its thorough establishment would produce a condition obviating all the objections of Mr. Nostrand is doubtful, for these, in part, imply the necessity of instruction in branches which belong to the regular academic college course, and the introduction of which into a technical course would involve sacrifice in the scientific curriculum. None can dispute, however, the value of such supplementary training. Aside from broadening the horizon of the mind—or perhaps as a consequence of this—the graduate would be the better qualified to meet men in all the relations of life on an even footing. The writing of reports and technical correspondence are no mean part of an engineer's work, the proper discharge of which implies a certain training of the literary faculty, not only that a technical case may when necessary be presented so as to be fully understood by the layman, but also so presented as to be most apt to influence favorable decision even when addressed to a master of technics. These considerations point not so much to the advisability of including in a technical course some of the ordinary college studies, as they do to the desirability of an academic college course preceding a technical one. The careers of some of our most successful younger engineers seem unquestionably to indicate that the young man who has followed both courses is much the surest of unqualified success.

Whatever the future may develop, the graduated electrical engineer has at present no cause for complaint as to limited opportunities, at least so far as concerns the industry for which he has been directly educated. In every branch of the electrical industry we find him represented, and if the present tendency continues it will be but a few years when he shall monopolize practically every position of profit in the industry, whether technical, administrative or commercial. It is well that this situation exists, for the disproportion between the number of purely technical positions of profit and the number of graduates is so enormous, that otherwise our technical schools would long ago have been confronted with a crisis. As it is, the present supply of electrical engineer graduates, great though it is, appears to be less than the demand, an indication of which fact is given in a note in another column, wherein it is stated that the graduates of one of our largest electrical engineering courses were last year eagerly bid for two or three times over. While this is most comforting, it is none the less desirable to keep in sight the fundamental considerations apt to govern in after life the success of the coming technical graduate. For the youth who to-day starts his education may, when graduated, encounter conditions less favorable than existing ones with respect to competition from other sources for the prizes that arise in other than the purely technical branches of industrial life—which outnumber perhaps as twenty to one those available to the electrical specialist *per se*.

The International Trade Relations of the United States.

"What has caused so much produce, merchandise and specie of the United States to go out of the country without the ordinary corresponding return?" is a question recently propounded to the Treasury Bureau of Statistics by Mr. Dadabahai Naoroji, an Indian gentleman residing in London. Mr. Naoroji, in his inquiry address to the Bureau of Statistics, quotes the recent figures showing a large excess of exports of merchandise and specie over the net imports of merchandise and specie, and says: "In India a heavy net excess always takes place because the system of government of India compels a heavy tribute, i. e., compels a large drain of the produce of India to England without any material return of merchandise or specie. But America is not under such a draining system of an alien foreign government; and I therefore desire to know the causes, and their extents, of such heavy net excess of exports of America's wealth or produce, and how this large 'balance of trade' is expected to be settled."

The following is an extract from the interesting reply of the Chief of the Bureau of Statistics: During the period immediately following our Civil War great internal development of our railways and manufacturing occurred. Much foreign capital was brought into the United States for use in this development, and during that time and in subsequent years railroad and other securities were largely marketed abroad. The commercial results of this development of railways and manufacturing establishments, including the opening of new fields of production, was an enormous increase in the exportations and a disposition to relatively decrease the importations because the development of manufacturing was making it practicable to produce at home from our own materials much which was formerly brought in from abroad. Thus the great business development of the years 1870 to 1890 had a tendency to stimulate production and exportation, but discouraged importation, and, as a consequence, exports exceeded imports in a constantly increasing ratio. The fact, however, that large sums had been borrowed abroad for the internal developments above alluded to required payments of large sums for the annual interest charges, and thus absorbed a part of the proceeds of the surplus exports. The earnings of foreign capital invested in great enterprises in this country, other than that obtained by the sale of bonds or by direct loans, also require considerable sums for the payment of the dividends and profits of the enterprises in which it was invested. The further fact that internal commerce and investments in internal developments were extremely profitable, reduced and temporarily suspended shipbuilding in the United States, and, as a consequence, the increasing traffic came to be carried more and more in foreign ships, and the payment of the freights thereon, especially the freights upon imports, again absorbed a large additional amount of the proceeds of the excess of exports.

Another factor to be considered is that of the money expended by Americans traveling abroad who usually take their funds in the form of letters of credit, and draw from time to time for such sums as they require, and this, of course, proves an offset to that extent against the balance which would otherwise be returned to the United States in the form of cash.

Until recently these four great factors—(1) the payment of interest on American securities held abroad, (2) the payment of earnings of foreign capital invested in business enterprises in the United States, (3) the payment of foreign freights carried in foreign vessels, especially freights on goods imported into the United States, and (4) the expenditures of Americans traveling abroad—have been considered the chief cause of the fact that the exports of merchandise so much exceeded the combined imports of mechandise, specie and bullion. Within the last two or three years, however, three further factors have apparently been added—(1) the cancelation of American indebtedness abroad, including a return to the United States of the railroad and other securities thus held; (2) the sale of foreign securities in the United States, such as the German, British and Russian securities which were placed upon the markets here during the last year, and in most cases quickly taken to the amount of probably $100,000,000 in the year, and (3) the credits which now stand abroad in favor of our exporters, and which are permitted to so stand because better interest rates could thus be realized than by insisting upon their immediate payment.

The sums of money represented by these various factors which presumably about equal the excess of exports over imports have been variously estimated, and up to the present time no means of obtaining more than estimates have been devised. These estimates usually put the amount paid to foreign vessels as freights on imports at about $50,000,000; interest on, and earnings of foreign capital, $75,000,000 to $100,000,000; money expended abroad by Americans, $75,000,000 to $100,000,000; American funds invested in foreign securities in 1900 about $100,000,000, and credits permitted to stand abroad in 1899 and 1900, each $75,000,000 to $100,000,000, to which must be added the amount of our foreign indebtedness actually canceled by the return of securities for which no definite estimate has, so far as I am aware, been made.

The United States is rapidly increasing her production, especially of the minerals and of manufactures for exportation, while the rapid development of our manufacturing industries steadily reduces the relative importations of manufactured goods, though the raw materials required for our manufacturers, especially those of a tropical and sub-tropical nature which we cannot produce at home, are constantly increasing, as are also the tropical foodstuffs of which we do not produce a suffcient quantity to meet our own requirements. The fact that we are rapidly becoming a creditor instead of a debtor nation will reduce to a minimum and wipe out the annual balance for payment of interest on our securities held abroad, and finally for the liquidation of those securities, and to this extent the absorption of our favorable balance of trade will be rapidly reduced, while the present disposition to encourage the re-establishment of our shipping industry in a sufficient volume to carry our growing commerce seems to justify the expectation that this drain upon our surplus may be at least somewhat reduced in the near future. Our foreign credits, as above alluded to, have increased largely during the last few years, and foreign obligations have been taken by investors in the United States in large sums, but it seems at least probable that two of the factors which absorbed a considerable share of the favorable balance, viz., the payment of interest and indebtedness abroad and payment of freights to foreign vessels, will within a comparatively short time be materially reduced, and thus require a settlement with specie and bullion of a larger proportion of the trade balance than has been the case in former years.

Capital Punishment.

According to a recent special dispatch from Pittsburg, Pa., a measure to change the mode of capital punishment for United States criminals sentenced to death will be introduced at the next session of Congress at the instance of the Allegheny County Medical Society. The bill will prescribe asphyxiation by carbonic acid gas, instead of the hangman's rope and the electric chair. The agitation for a more humane method of execution was taken up by the Allegheny County Medical Society seven years ago, and a committee was appointed. Statistics were gathered to show that the present modes of inflicting the death penalty had a degenerating effect on the inhabitants in communities where the deaths took place. Nervous disorders of extraordinary kind had attacked persons of sensitive temperatment. The Pennsylvania State Medical Society became interested in the investigations and the discussions in that body attracted the notice of other medical societies in this country and in Europe. It is not the object of the bill to make the punishment less terrifying for the criminal's sake.

Wanted the Whole Class.

June *Success* contains an article by President J. G. Schurman, of Cornell University, in which he says: "It is true that there is an increase and, just now, an unusual demand for college-bred men in all walks of life. The prescribed preliminaries to legal and medical education are, step by step, approaching graduation from college, and have reached it, in some instances, while these professional courses themselves have been extended and deepened, till they are now nearly or quite on a par with the old liberal training with which they are co-ordinated in the modern university. As to engineers—15 years ago, the manufacturers of machinery had to be coaxed to take those pioneers, the Cornell men, into their shops and give them a chance. But where one went many followed. Last spring, when the class of 1900 came to graduation, every student in this branch was eagerly bid for two or three times over. One great electrical firm alone asked to be given the entire class. There is observable, too, a gradual increase in the call for college-bred teachers in the public schools, and this demand will grow by what it feeds upon. All this is but the sign and symbol of an increasing complexity and organization in our civilization.

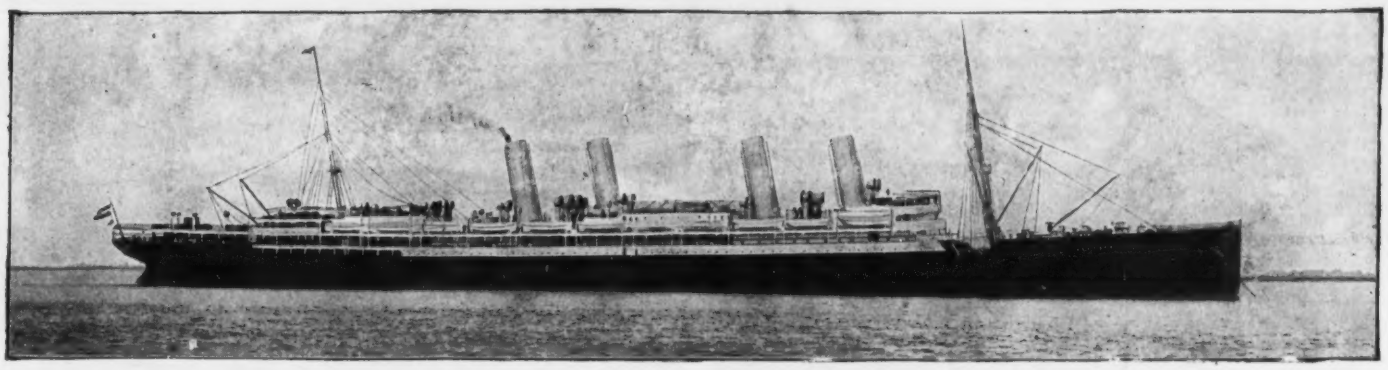


FIG. 1.—THE STEAMER "DEUTSCHLAND."

Electric Light and Power Installation on Steamer "Deutschland."

THE fast mail steamer Deutschland, of the Hamburg-American line, can justly be termed a masterpiece of German shipbuilding. All branches of technical industry have been united, and have done their best to attain this splendid result. A prominent share can be claimed by electrical engineering, as the plant for illumination and transmission of power comprises what amounts to a large electric supply station. The entire electrotechnical part was designed and constructed by the Allgemeine Elektricitats - Gesellschaft, Berlin. Two thousand five hundred and fifty incandescent lamps were required for illumination, while 23 electric motors are used for operating the various supplementary machines.

FIG. 2.—SMOKING-ROOM LIGHTS.

Five units are used for generating the required current, each consisting of a vertical compound steam engine of C. Daevel, Kiel, coupled direct to a continuous-current dynamo. The speed of these engines is 250 r. p. m., and the e. m. f. is 110 volts. Three of these steam engines have cylinders 300 and 500 mm. in diameter, with a stroke of 255 mm., while each of the corresponding dynamos gives an output up to 700 amperes. In the remaining two smaller steam dynamos, the diameters of the cylinders are 270 and 450 mm., respectively, and the stroke 200 mm., each of the corresponding dynamos having an output of 400 amperes. The windings of the dynamos are provided with special insulation. The magnet frame is composed of two parts, so as to readily enable the armature to be replaced in the limited space. The commutators are made of a special width and the current is collected by carbon brushes.

Four of the steam dynamos, viz., the two larger and the two smaller ones, are in the dynamo room behind the main engine rooms, between the two propeller shafts (Fig. 5). The fifth dynamo is in a second smaller dynamo room, which is likewise accessible from the main engine room, but situated on the main deck above the water level (Fig. 4). By this arrangement sufficient illumination is given by the upper machine, even if the lower machines are prevented from supplying current. The current is conveyed from the four dynamos through iron-wire armored lead and rubber-covered cables to the main switchboard situated in the same room. The current is also conveyed in a similar manner in the upper engineroom to the smaller switchboard located therein; and from these switchboards to the main circuit. This is composed of three principal parts, viz., the so-called pilot lighting plant, the general lighting plant and the plant for transmission of power.

The pilot lighting system comprises all the lamps which are required for service, and also for the safety of the vessel, passengers and crew, especially for the illumination of the engine and boiler rooms; also the lamps which are required for harbor duty, for cleaning the saloons, and for the cabins of the crew. All the remaining lamps are connected to the circuit for general illumination. The circuits of the pilot lighting plant are fed from the switchboard in the upper dynamo room, while the general lighting and the power circuits are fed from the main switchboard in the lower dynamo room.

Since the dynamos are not worked in parallel, the arrangement is such that by means of four-part two-way switches each of the lower dynamos can be connected up to any circuit of the general lighting or to the bus-bars of the power plant. By a similar switch it is, however, also possible to connect up each dynamo onto the switchboard in the upper engineroom, i. e., to the pilot lighting plant, for which purpose, a trunk main is provided between the upper and lower switchboards. This conductor is in direct connection with a two-way switch, by means of which any one of the lower dynamos or the upper dynamo can deliver its current to the upper switchboard. Consequently, by this system of connection any desired transmission of current can be effected in a simple manner, and an arrangement is provided whereby any one dynamo can be readily substituted for another.

Dead-beat instruments made by the A. E. G. are used as measuring instruments as they work accurately in any position, notwithstanding the rolling movements of the vessel. The main conductors, leading through the boiler and enginerooms and through the bunkers are rubber and lead-covered cables armored with iron wire, secured to the hull of the vessel. Wires provided with a strong seamless rubber insulation and laid in impregnated wood casing serve as main conductors in the remaining compartments. Where the conductors enter water-tight bulkheads, they are fixed in metal stuffing boxes mounted in the bulkhead.

In the engine and boiler-rooms, the conductors are connected as a ring main, to which are attached water-tight boxes for the single lamp circuits. Each box contains eight branch circuits, each for one lamp,

FIG. 3.—ILLUMINATION OF MAIN SALOON.

with the necessary safety fuses and cut-outs. The cables are made water-tight within the box by means of stuffing boxes, the lid of the latter being likewise made water-tight by means of an india rubber packing and two screws. Each of the conductors leading from these boxes and intended for one lamp, consists of twin iron-wire armored, lead-covered cable with 2 by 1.5 square millimeters sectional area of copper.

The lights for the engine and boiler rooms are provided with pro-

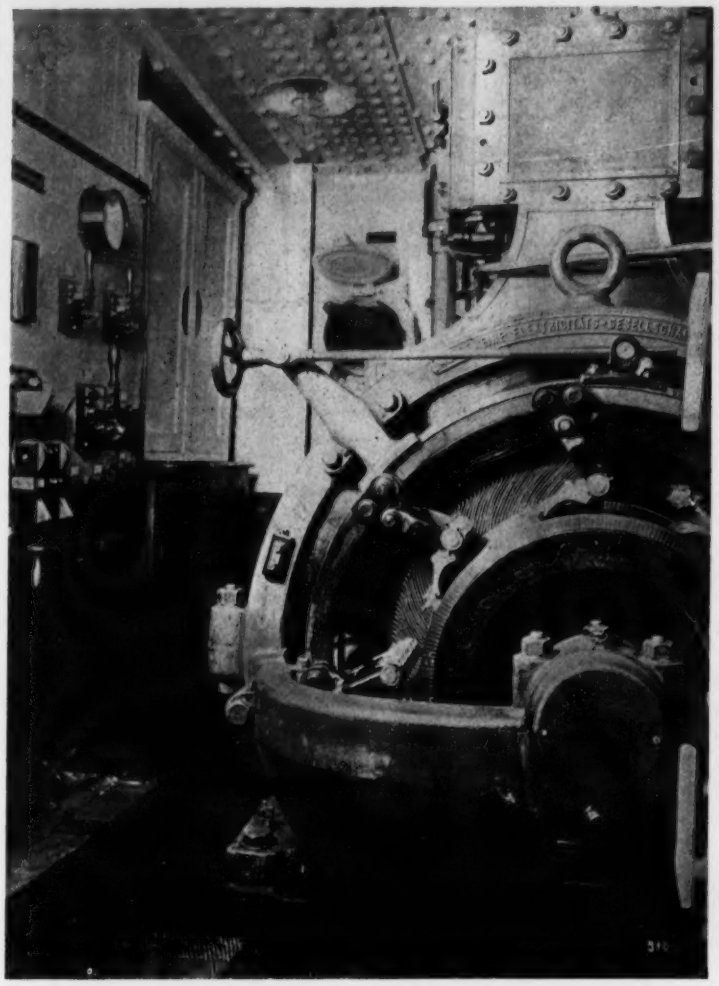


FIG. 4.—SMALLER DYNAMO ROOM.

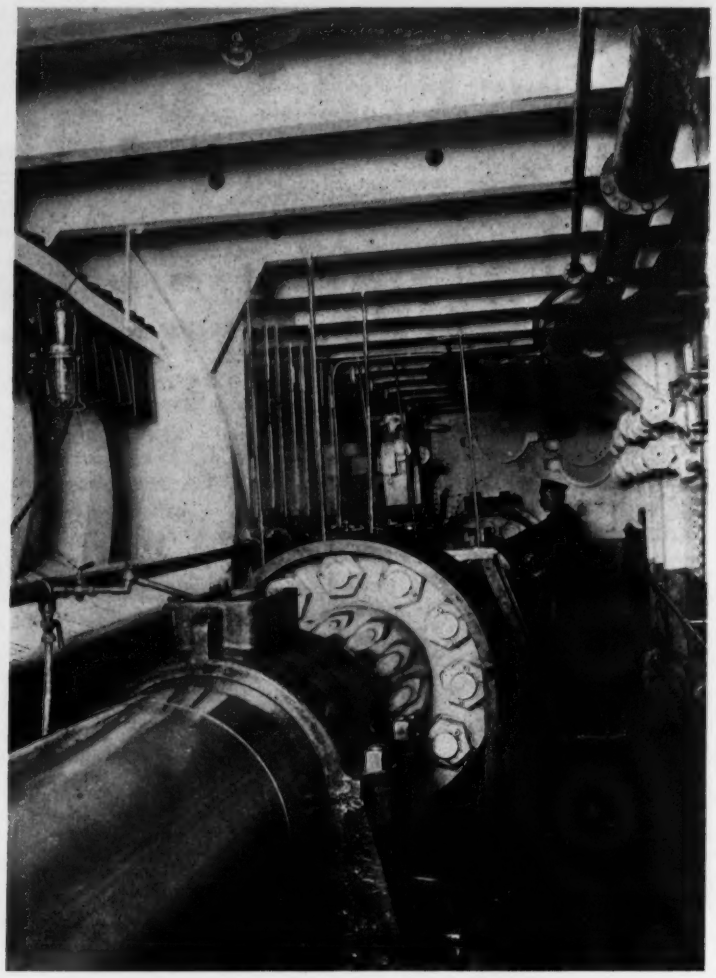


FIG. 6.—LIGHTING IN THE SHAFT TUNNEL.

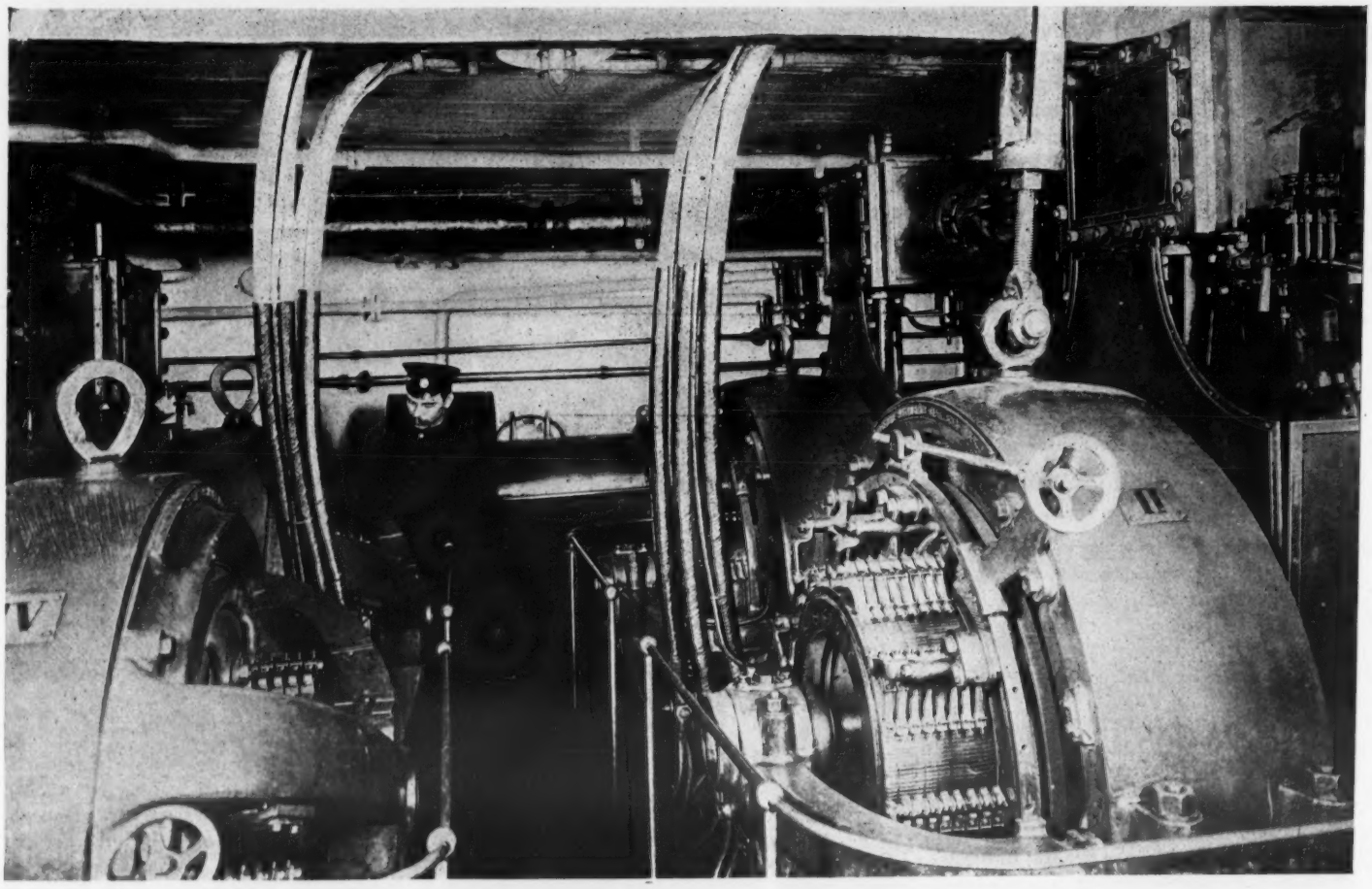


FIG. 5.—MAIN DYNAMO ROOM.

ELECTRIC LIGHT AND POWER INSTALLATION ON STEAMER "DEUTSCHLAND."

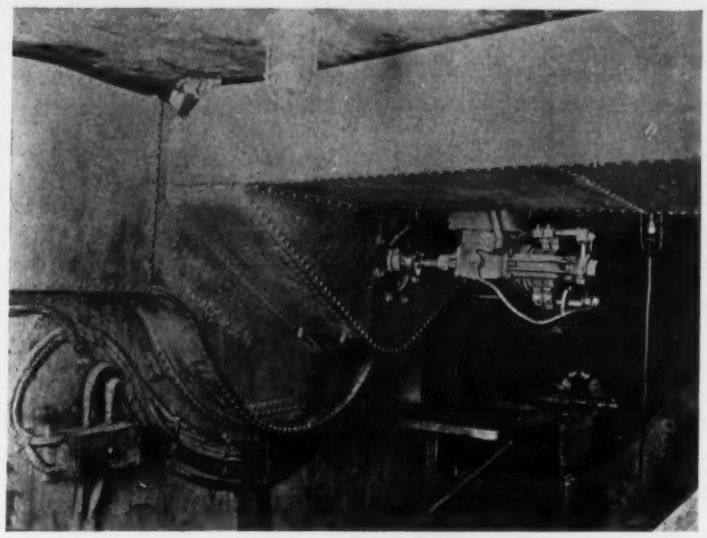


FIG. 7.—A VENTILATING MOTOR.

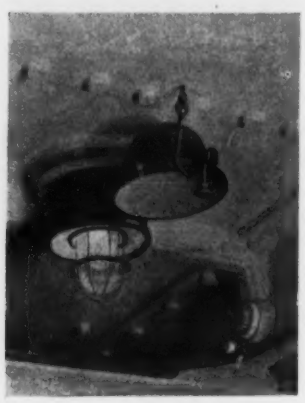


FIG. 10.—LAMPS IN STEERAGE AND STORAGE.

FIG. 8.—BUOY AND SIDE LIGHTS.

FIG. 11.—PORTABLE DECK CLUSTER REFLECTOR AND CORRIDOR LIGHTS.

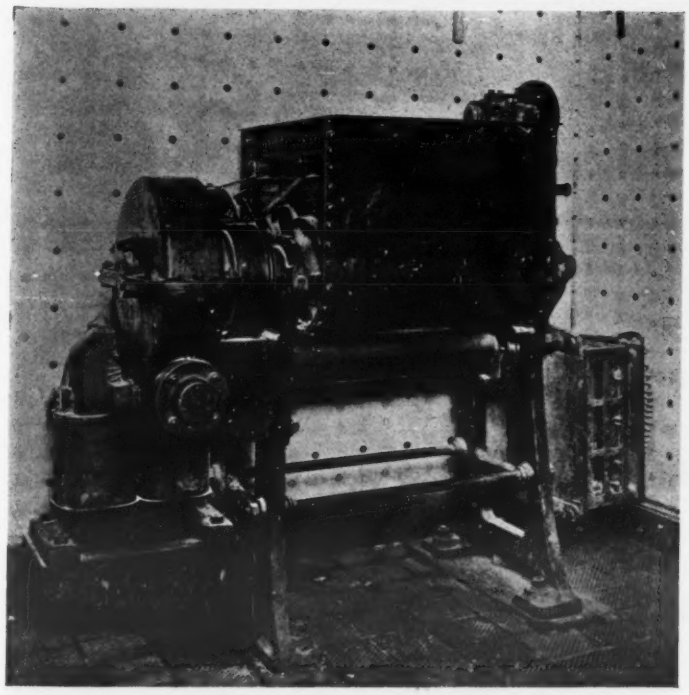


FIG. 9.—KNEADING MOTOR FOR SHIP'S CONFECTIONER.

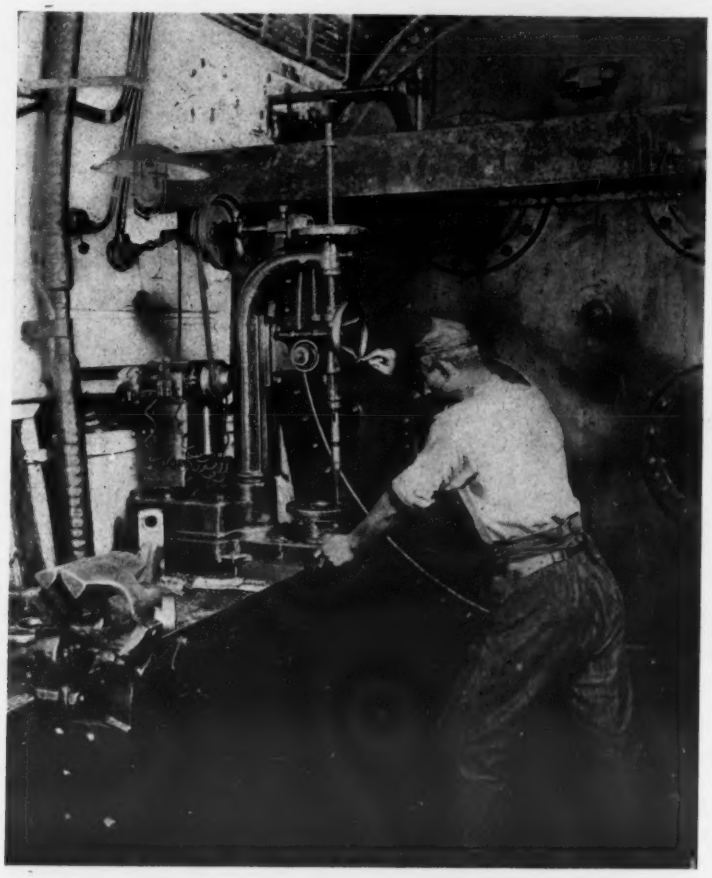


FIG. 12.—MOTOR IN ENGINE-ROOM.

ELECTRIC LIGHT AND POWER INSTALLATION ON STEAMER "DEUTSCHLAND."

tecting glasses and wire baskets. They are secured either directly to the bulkhead, or if situated near the center of the engineroom they are connected to long, bent gas pipes. In every case the cables are inserted water-tight. In addition to the fixed lamps, there are numerous water-tight contact plugs for portable hand lamps. The lighting of the shaft tunnels and of the hold for the cargo is arranged in a similar manner, some of the fittings being provided with reflectors.

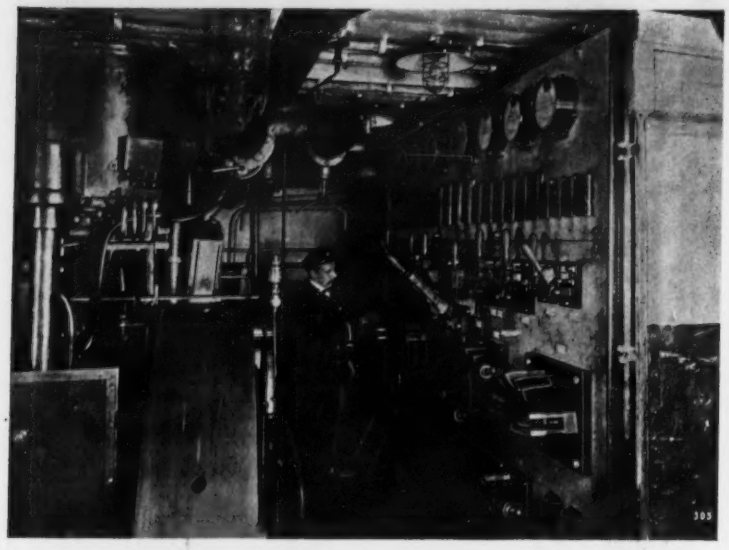


FIG. 13.—MAIN SWITCHBOARD.

As in the branch-circuit boxes in the engine and boiler rooms, there are provided in the remaining parts of the vessel distribution boxes, from which the conductors lead to the lamps. A large number of lamps are, however, always connected up to each single circuit. The boxes are distributed in such a manner that those spaces, which, by their position or their use constitute a group, have always one common distribution box. Each box consists of a marble slab, upon which the necessary switches and safety fuses are provided, and embodies both the pilot lighting and the general lighting plant, for which the back part is provided with separate bars having a separate current supply (Fig. 14).

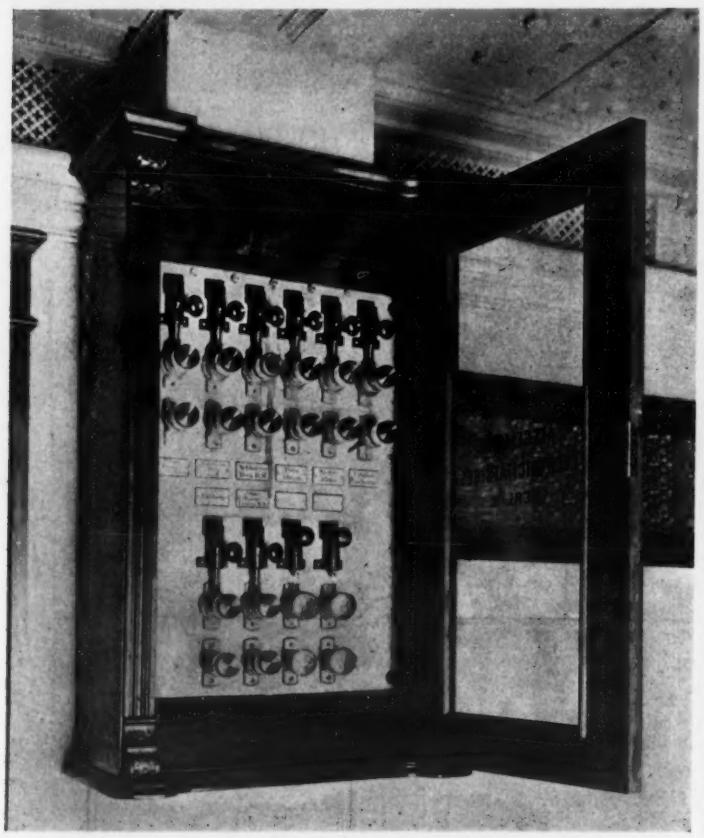


FIG. 14.—A DISTRIBUTION BOX.

The connection of all the conducting wires takes place at the back of the distribution box, from whence the wires are led into the adjoining wood casings. The boxes are made of polished teak wood and have doors with panes of glass. The single switches are provided with small plates, on which the individual circuits are indicated. All circuits are secured by 10-ampere plug fuses.

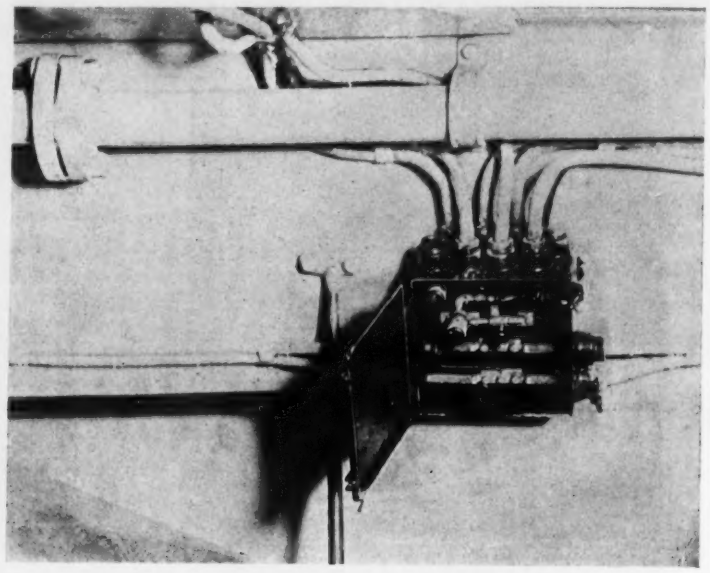


FIG. 15.—WATER-TIGHT BOX, ENGINE AND BOILER ROOM.

The distribution of the circuits is such that, on an average, six incandescent lamps are switched on one circuit, and in the cabins up to six contact boxes are provided. Only in the saloons, where electroliers having several lights are used, do circuits up to 12 lamps come into consideration. Each passenger cabin contains a lamp with two on and off switches, one being provided on the door and the other at the head of the berth. There is also a wall plug for a curling tongs heater or for ventilating fans.

FIG. 16.—LIGHTING ON PROMENADE DECK.

The staterooms are more amply provided with electric light, and the same remark applies to the sitting rooms of the captain, chief engineer, assistant engineer, first mate and physician. The staterooms are also furnished with electric-heating apparatus, stoves

being provided in the sitting, sleeping and bathrooms. Those passenger cabins which face the sea and consequently have the benefit of daylight, are also connected to the general lighting plant, while those located towards the interior of the ship and consequently dark in the daytime, are connected to the pilot lighting plant.

The lamps in the rooms for the steerage passengers are provided with water-tight protecting glasses and wire baskets, like the engine-room lights. They have, however, also a cast-iron protecting casing, which is opened when the rooms are occupied by steerage passengers, but can be closed when these rooms are employed for stowing cargo. In the gangways between the cabins are provided more artistic fittings, with dim glass globes (Figs. 10 and 11).

In the numerous rooms which are furnished in gorgeous style for the general use of the first-class passengers, the electroliers are of elegant construction, while all the electric leads are fixed behind the woodwork of the ceiling and walls. Special reference may be made to the first-class saloon in the middle main deck, the large light-shaft of which extends through all the three superposed decks (Fig. 3). The first-class drawingroom and first-class smoking saloon on the promenade deck are also provided with the electric light in a manner suitable to their requirements (Fig. 2).

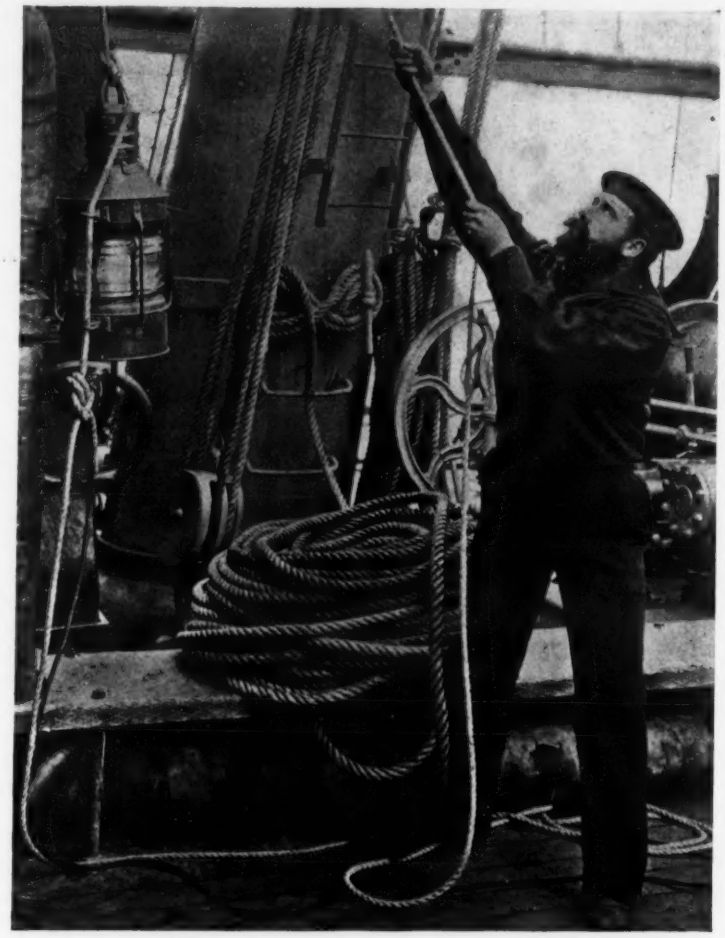


FIG. 17.—HOISTING THE MAIN TOP LIGHT.

The promenade deck which is practically open (Fig. 16), is provided with special flat water-tight fittings. Near the cargo openings, coal doors, likewise suituated on the promenade deck level, are provided water-tight plugs for connecting hand lamps and reflectors, which are employed for illuminating the promenade deck during loading and unloading, when getting coal on board and also on special occasions. All the signal lights are operated with electric lamps, especially the two ship's side-lights and the main top light. The latter is secured to the mast by means of a rope, the current being supplied through a flexible cable (Fig. 17).

In order that the captain or officer on duty may have constant knowledge that these lamps, which are most important for the safety of the ship, are burning properly, they are directly connected to an electromagnetic controlling apparatus, located on the bridge deck. This apparatus has three openings, which are closed by white, red or green panes of glass, and show the same color when the corresponding signal lamps are burning, while that pane of glass is immediately obscured when the circuit of the corresponding signal lantern fails. The poop lantern and some lamps on the fore and quarter decks are constructed like the engineroom lights.

The power transmission plant of the Deutschland comprises 23 motors. More than half of these serve for driving fans for the ventilation of the different lower rooms of the vessel. Two of these ventilators, which are erected on the upper deck provide for the fresh air supply in the cabins of the engine drivers and stokers. Four other larger fans serve for ventilating part of the stoke hold. The motors, the shafts of which are coupled directly to the shafts of the fans, are suspended from the ceiling of the boiler rooms. Nothwithstanding the coal dust, which is, of course, always present, and the unavoidable accumulation of moisture and dirt, the motors run constantly and quite satisfactorily, without special attention or supervision. Besides various elevators for coal, provisions, mail bags and the like, a kneading machine in the confectionery department is operated by a motor, with worm gearing. The starting resistance is situated close to the motor. In the enginerooms there are two electrically-driven drilling machines used for making small repairs during the voyage (Figs. 7, 9 and 12).

For all parts of the electric plant, the necessary spare parts are also on board, and a special set of men attend to the entire electrical apparatus on board under the supervision of two electrical engineers. Since the Deutschland was commissioned for service, the electric apparatus has been working day and night continuously and satisfactorily.

Installing the Electric Conduit System on Broadway, New York.

In a brief seven or eight years the cable has quite outgrown its usefulness on Broadway, New York City, and this week is being replaced by the conduit trolley from the Battery to Central Park. Large numbers of men have been thrown on the work, which President Vreeland is driving with all his wonted energy. The Metropolitan Street Railway Company's officers hope that all the electric cars will be in operation by the middle of the week. Under the surface of Broadway there are between four and five thousand moving parts, all of which were removed before the conductor-bars for electrical traction could be put in place. For instance, on the Tenth Street curve there were 40 wheels; on the Fourteenth Street reverse curve there were 350 wheels between the Morton House and Tiffany's; on the Seventeenth Street curve there were 40 wheels; thre were great terminal wheels, 12 ft. in diameter, at South Ferry, at Houston Street, at Thirty-sixth Street, and at Fifty-ninth Street. As these wheels were built into the road and were set before the track was laid, it was necessary to break them up in the pits into pieces small enough to be removed through the openings.

The 3500 small sheave wheels on which the cable rests along the straight runs of the road also had to be removed through the manholes. About 200 electrical connections had to be made, 8000 plugs removed, and between 36,000 and 40,000 bolts set, before the current was turned on; and none of this work could be done until the cable, which aggregates in length 117,000 ft., and weighs about 3½ lbs. a foot, had been removed. The new material was all ready and waiting.

Yerkes and a London "Rustler."

There are Western "rustlers," but London has them, too. It is reported that one morning not long ago Mr. C. T. Yerkes, who is now engaged in London on underground railway enterprises, received the following letter: "Dear Mr. Yerkes: I have seen by the papers how rich you are, and also I have seen your picture, which looks kind. So I thought I would tell you that my parents are poor, and depriving themselves of many comforts in order to give me a good education. Among my school friends there is a gymnastic club, of which I am a member, and all the girls wear silk skirts; and it gives me the horrors to feel I can't have one, when I hear the fascinating rustle of their petticoats. Would you send me $5 to buy one? Yours, etc."

Mr. Yerkes received the unique epistle from his secretary and, to the latter's astonishment, exclaimed: "Send her the money. It will give more pleasure than if invested in any other way."

The money was sent, and the acknowledgment was as follows: "Dear Mr. Yerkes—Thanks so much for the money. I invested it, and can now rustle with the others."

FIG. 1.—COLONIAL HOTEL, NASSAU, BAHAMA ISLANDS.

An Isolated Plant at Nassau, Bahama Islands.

HENRY M. FLAGLER, well-known through his connection with the Standard Oil Company, has probably gained his widest reputation from the many business interests which he has developed in the State of Florida. Mr. Flagler, aside from developing the agricultural conditions of the State and building a railroad running throughout its length, has expended millions of dollars in providing comfortable and luxurious hotels along the 300 miles of the eastern coast of Florida. These hotels are the means of such enjoyment and health to those who winter on the "American Riviera," that Mr. Flagler may be said to have attained the object of the search of the famous historic explorer in Florida, and discovered the Fountain of Youth.

Mr. Flagler's efforts as "host" in the United States have been so much appreciated that he recently determined to extend his hotel system and enter British territory. About two years ago he purchased what is now the Royal Victoria Hotel at Nassau, Bahama Islands. This old hotel was remodeled and immediately proved so attractive a resort that it was found necessary to erect a new, larger and in every respect modern hotel, which was opened a little over a

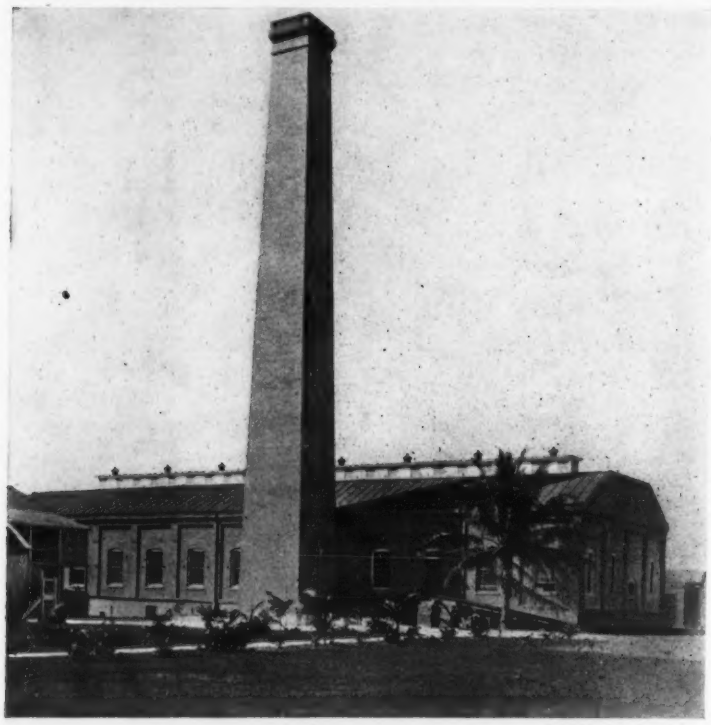


FIG. 2.—EXTERIOR OF POWER HOUSE.

year ago and christened the "Colonial" (Fig. 1). To-day rumor says Mr. Flagler is to further extend his influence and has already entered into a contract with the Mexican Central Railroad to build and operate a number of large hotels in Mexico, and there is also talk of his erecting hotels in Cuba.

The Royal Victoria Hotel at Nassau, is located on an eminence overlooking the small but beautiful land-locked harbor. It is the same old hostelry, famous in Civil War times as the headquarters of blockade runners carrying cotton out of the Confederate States. The new hotel, the "Colonial," is erected on ground formerly occupied by Fleming's Square and the Government barracks. It is built in the form of a letter E, facing and located directly on the shore of the harbor.

Nassau is not well equipped for providing the many and varied wants of the capricious and exacting winter tourist; consequently, nearly everything that a hotel requires must be imported from the United States or manufactured on the hotel grounds. To supply both the Victoria and the Colonial with light, power, steam and ice, it was decided to erect a large and suitable modern power house, the equipment of which is the subject of this article.

The general exterior appearance of the building is shown in Fig. 2. It will be noticed that ample ventilators in the roof are provided, as the temperature inside, even in winter, with everything open, frequently reaches 110 degs. or 115 degs. The plans of the power house and ice plant are shown in Fig. 3. As seen, the dynamo room is separated from the boiler room by a brick partition extending clear to the roof.

In the boiler room are three 200-hp Babcock & Wilcox water-tube boilers furnishing steam at 150 lbs. pressure. Space has been left for a fourth unit to meet future demands. All the boilers are equipped with Murphy automatic stokers and a special coking furnace designed to consume the garbage received from the hotels. No convenient method for disposing of the hotel garbage was economically available, as it could not be buried, owing to the coral formation of the islands. It was therefore considered necessary to arrange to burn the refuse in order to dispose of it. In practice, however, it has been found that the native islanders are glad to take the garbage for "home consumption," and in consequence the demands on the refuse destroyer are comparaticely few.

The power house stack is 125 ft. in height and 5 ft. inside diameter. It is built of brick imported from the United States. The boilers are connected with the stack by an underground brick oval flue.

In the dynamo room are four Ball & Wood 10-inch and 20 by 16-inch tandem compound condensing engines, each direct connected to a 100-kw General Electric two-phase, 60-cycle, 2100-volt alternator, running at 225 r. p. m. The generators are of the revolving field type, with direct-current compounding devices. There are two surface condensers of the Wainwright type, each capable of taking care of two engines. Salt water for condensing is taken direct from the harbor. There are two special horizontal 300-hp heaters for feed water, which are of the even-flow corrugated seamless tube Wainwright type; also one Webster 800-hp combined heater and filter. The condenser pumps, boiler feed pumps and all the pumps for house supply and fire use are of the Deane manufacture. Those used in connection with the ice plant were furnished by the Stilwell-Bierce & Smith-Vaile Company. The high-pressure steam piping is all of extra heavy pattern, and was completely laid out, cut and fitted in New York before shipment. All drips are returned to a partitioned hot-well where the oil is separated and the water again used in the boilers.

On account of the formation of the island, all drinking water and that used for ice-making at Nassau must be accumulated during the rainy season, which is over about the time the hotels open for winter tourists in December, and stored in cisterns. Ocean water is used for condensing and fire purposes. Wells dug on the island yield a brackish water; which, after treatment in purifying apparatus furnished by the We Fu Go Company, is suitable for flushing in the hotels and supplementing the rainwater used in the boilers.

As coal of very ordinary quality costs in the neighborhood of $7

per ton delivered at the power house in Nassau, the question of steam economy was a very important one, and determined the engineers in deciding not only that a condensing plant was necessary, but also that all small power units should be driven by motors rather than by small steam engines. It was found that with the economy guaranteed for the 150-hp direct connected units, less steam per horse-power would be required in operating motor-driven pumps and an ammonia compressor, located even directly alongside of the generators in the dynamo room—taking into consideration the various losses in transformation through the generators, switchboard, transformers and motors—than would be consumed by small steam pumps or a direct-acting compressor of moderate cost. The pumps installed

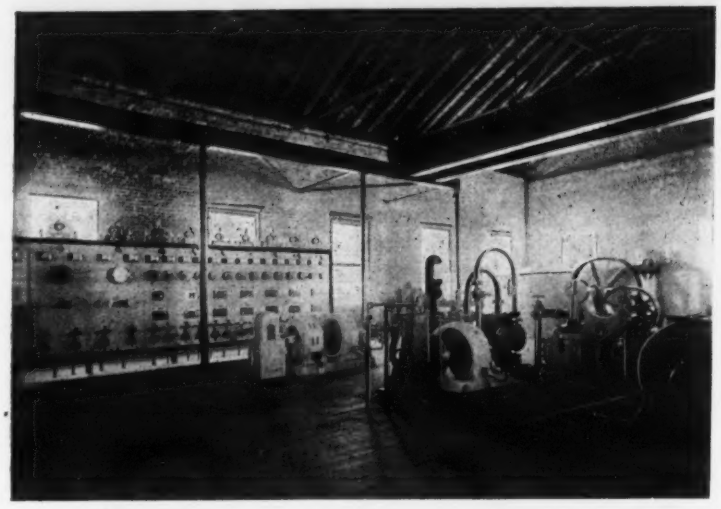


FIG. 3.—ELECTRICALLY-DRIVEN PUMPS.

are used for taking the rainwater from the cisterns and distributing it for the various uses throughout the hotel; also for supplying water to the ice-making plant and brine to the refrigerating boxes in the hotel, etc.

Because of the poor economy of a small engine, a direct-connected polyphase motor-exciter set was installed, and is used for supplying the field currents to the alternators under the usual conditions of operation. A duplicate exciter, direct-connected to a 7 by 6 Forbes vertical engine is used for furnishing direct current when first starting whenever, for any reason, the plant has been completely shut down. Both of these exciter sets are shown in the foreground of Fig. 3. The exciters and all the motors used in the installation were furnished by the General Electric Company.

On account of the distance of the hotels, particularly the Royal Victoria, from the power house and because of the comparatively large amounts of energy distributed and the further possibility of municipal lighting being undertaken, it was found desirable to use polyphase currents, and the two-phase system was adopted, using 60 cycles and 2100 volts.

Owing to the large number of feeder circuits and the use of polyphase currents, the switchboard is necessarily somewhat elaborate, as it is supplied with every necessary device for controlling, measuring and distributing the current to the various points at which it is used. The board is built of Italian marble mounted in an ornamental bronze frame and consists in all of 20 panels, of which seven are used for single-phase lighting, six for two-phase motor circuits, four for the two-phase generators, one for the exciters and one for power-house lighting, leaving one blank panel for an additional generator. Perhaps the points of special interest with regard to the switchboard are that the feeders are all equipped with circuit-breakers instead of fuses. The two-phase, four-pole high-tension dynamo-changing switches are equipped with double-spade handles of especially compact design gotten up by Mr. Floy, of the firm of consulting engineers for this plant, and the board throughout is provided with two sets of bus-bars, each consisting of four conductors permitting the separation of the motor and lighting loads when desired. Each of the generator and feeder panels is equipped with a recording wattmeter so that the output of the generators and the consumption of energy on the separate lighting or power circuits is accurately recorded. The total length of the board is 54 ft. The board complete was built by the H. Krantz Manufacturing Company, and in view of its complexity and the short time allowed in which to fill the order, much credit is due the manufacturer.

The underground system of distribution is used exclusively, and Fig. 9 shows the relative position of the hotels and power house, and the location of the underground system. Iron pipes connect the power house with the Colonial Hotel, but from the latter to the Hotel Royal Victoria are installed four-duct conduits, manufactured by the American Vitrified Conduit Company, with McGregor manholes.

Oil transformers of large size, 2100 to 112 and 224 volts, manufactured by the Pittsburg Transformer Company are used throughout the installation for both motor and lighting work.

The refrigerating plant was furnished by Messrs. Westinghouse, Church, Kerr & Co. It has a total capacity of 25 tons of refrigeration, of which 20 are for ice-making and 5 tons used in refrigerating boxes in the kitchen, and barroom of the Colonial Hotel. The plate system with brine circulation in both ice-making and refrigerating is employed. The ammonia compressor, which is of the quadruplex single-acting type running at 80 r. p. m., has cylinders 10½ inches in diameter, with 10½-inch stroke. The compressor is provided with a heavy band-wheel and belt-driven from a 50-hp induction motor. On account of the high temperature of the ocean condensing water, the compressor is rather larger than might be necessary under other

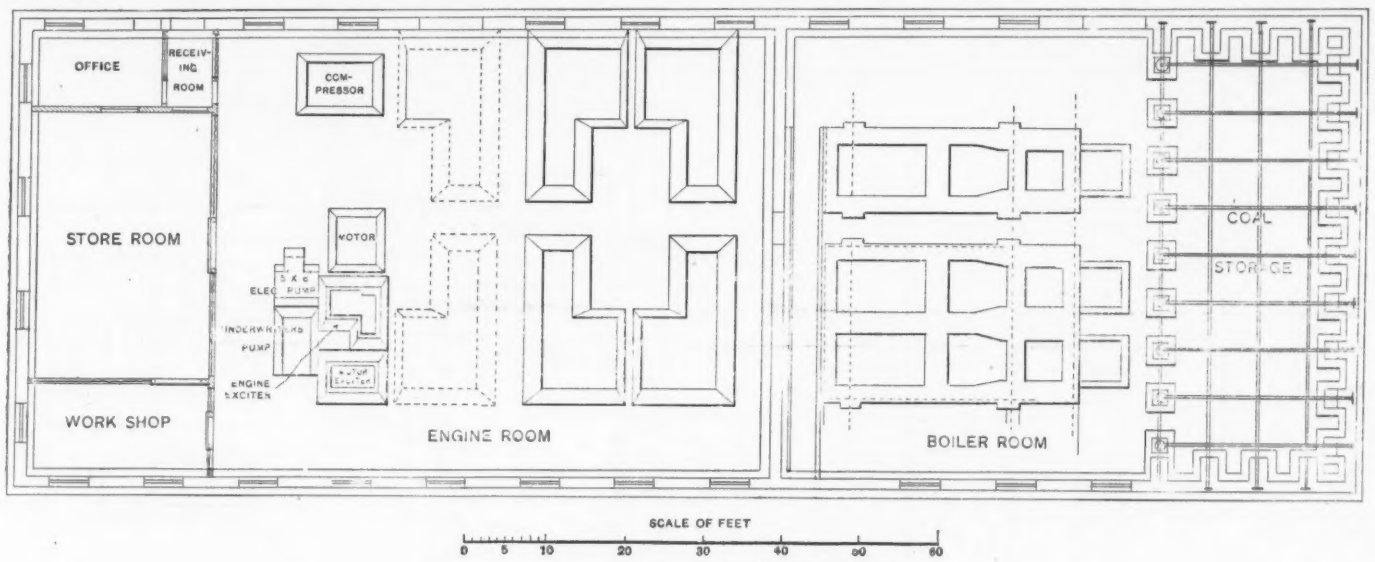


FIG. 4.—PLAN OF ENGINE AND BOILER ROOMS.

conditions, but it is so arranged that two of the cylinders may at any time be disconnected and thus operated under half capacity. In the ice-plant building are located the necessary motor-driven pumps for continuously supplying and circulating the water during the freezing process; also for forcing it through a circulating filter which is used to eliminate impurities in the water rejected in the plate system of freezing. The ice-tank is built of and lined with selected yellow pine dressed all over. The ammonia condenser is of the vertical atmospheric type, made up of extra heavy pipe with special cast-steel headers. For separating the ice from the coils steam cutters are used.

A geared traversing hand hoist with overhead ball bearing trolley and rail supported from the roof, permits the easy lifting of the ice from the tanks and transporting it to the cutting-up platform. In one end of the ice-plant building is an ice-storage having a capacity

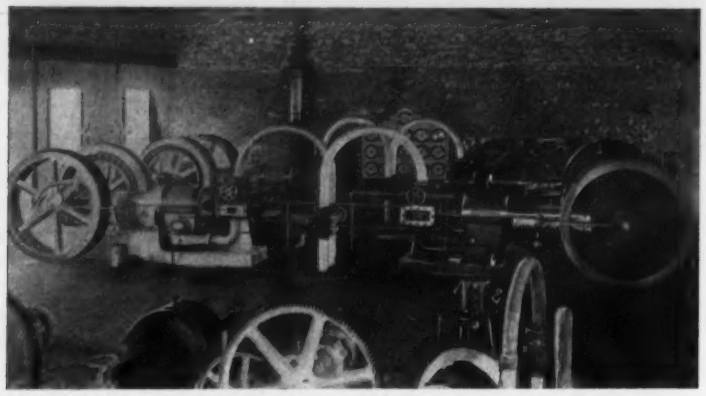


FIG. 5.—VIEW OF ENGINE ROOM.

of 75 tons. The ice plant is run continuously 24 hours a day during the hotel season, any excess ice being offered to the townspeople, by whom it is eagerly sought, as there is no other ice-making plant in the Bahama Islands.

Close adjoining the power house is a complete machine shop equipped with a lathe, drill-press, planer, etc., all power being furnished by a 10-hp polyphase motor.

The hotels have been furnished and equipped with all the modern improvements, such as electric call bells, electric fire-alarm systems, electric lights, electric elevators, electrically-driven printing presses in the hotel printing office; also electric irons and power in the laundry and live steam for furnishing hot water in the laundry, kitchen and bathrooms and also for cooking in the kitchen. The hotel grounds and piazzas are elaborately lighted by electricity.

The electric elevators in the Hotel Colonial are one passenger, one combined passenger and baggage and one laundry elevator; in the Hotel Royal Victoria, one combined passenger and baggage elevator, all furnished by the Otis Elevator Company and operated from two-phase motors. The passenger and baggage elevators have a speed of 150 ft. per minute, and the laundry elevator 100 ft. per minute. The elevator engines are of the drum, gear type, with a phosphor bronze worm-wheel engaging a solid steel forged screw. The elevators are provided with automatic safety stops for the upper and lower landings, and automatic electric controllers which regulate, independent of the operator, the rapidity with which the cars accelerate. Of course, each car is counterbalanced and equipped with the most approved form of safety appliance. The passenger cars are of ornamental wrought iron and mahogany, equipped with electric lights and annunciators.

For the drawings and illustrations which accompany this article, as well as for the details described, we are indebted to Mr. Henry Floy, of Floy & Carpenter, the consulting engineers, who had charge of both the design and installation of the entire equipment.

Automobile Mail.

Experiments are being made in Chicago by the Government with automobiles for and to mail carriers in delivering the mail. Some of the large buildings and firms in Chicago several blocks from the post office or sub-stations have such a volume of mail that it has become a great burden for the postmen to carry their mail sacks from the post office to the point where they begin to distribute the mail. It is thought that automobile buses for the carriers would improve the service and experiments are being made with a couple of such buses.

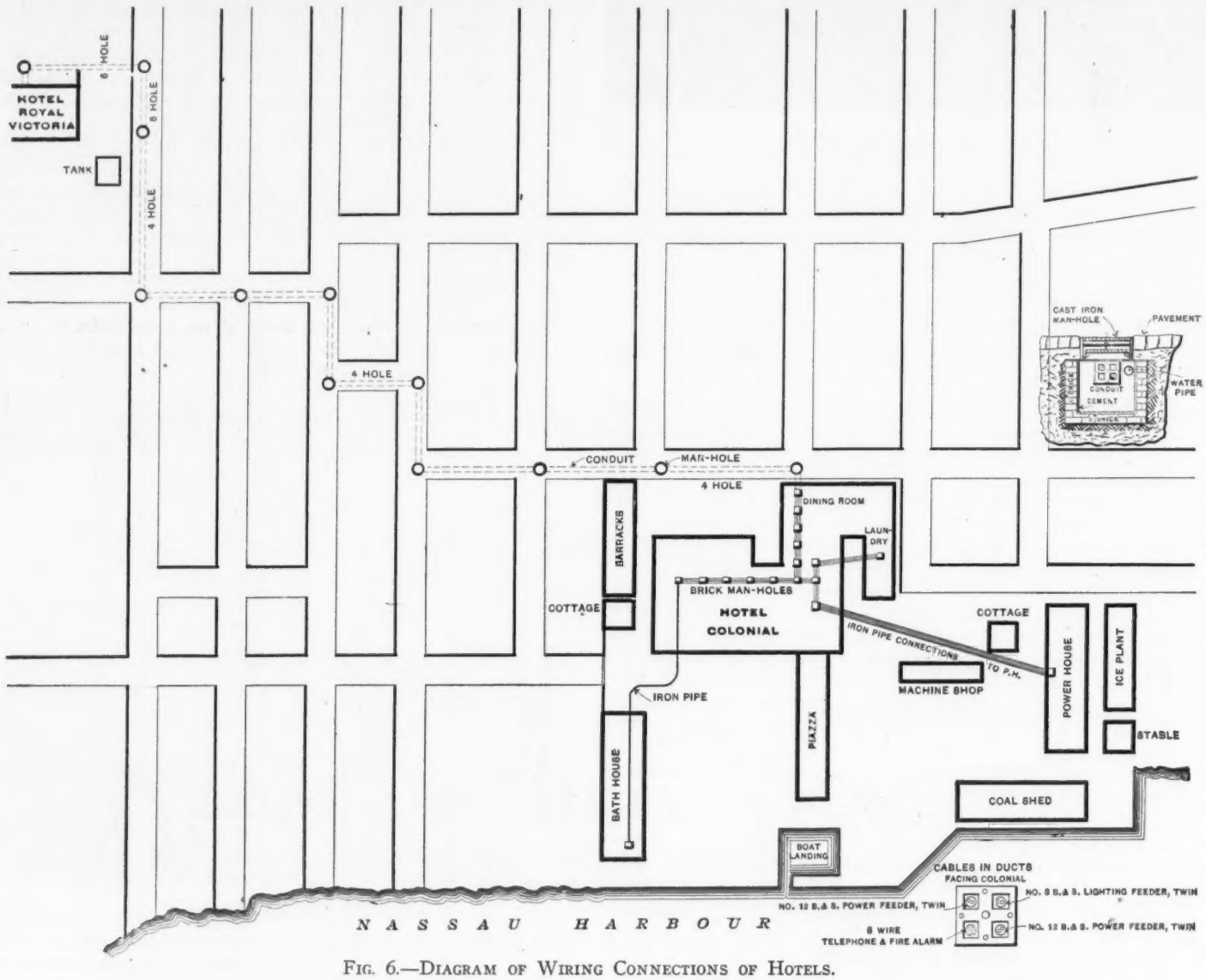


FIG. 6.—DIAGRAM OF WIRING CONNECTIONS OF HOTELS.

The New Trolley System in Glasgow, Scotland.

ONE of the latest and most important trolley systems to be installed in Great Britain is that at Glasgow, the second city in the country. The system is operated by the municipality under the direction of Mr. John Young, who is the general manager. The consulting engineer for the work has been Mr. H. F. Parshall, so well known on both sides of the Atlantic. The power house, at Pinkston, on the Dundas branch of the Forth & Clyde Canal, is built of steel frame supplied by Riter & Conley, of Pittsburg. The building is 244 ft. long by 200 ft. broad, by about 88 ft. high from the basement to the top of the walls. Each of the three rooms extends the whole length of the building, the boiler room being on the east side, with a width of 84 ft. The engine room, in the center, is 75 ft. wide, and the auxiliary plant room, on the west side nearest the canal, has a width of 40 ft. The heights of the various parts of the building vary also, that of the boiler room being 70 ft., that of the engine room 64 ft., and that of the auxiliary room being 52 ft. The two chimney stacks, which are of brick, ornamented with stone, have an internal diameter of 16 ft., lined with firebrick, and are each 263 ft. high. The general design of the whole plant is excellent.

The boiler house contains eight batteries of two boilers each Babcock & Wilcox, in two rows facing each other, with the firing floor between. Each boiler has a total heating surface of 5137 sq. ft.. and is constructed for a steady working pressure of 160 lbs. per square inch. The headers are provided with handholes placed opposite the end of each tube to permit of tubes being cleaned or renewed, each handhole being provided with cap fastened with bolt and clamp and cap nut. The sections are connected at each end to two steam and water drums 48 inches in diameter, by means of 4-inch tubes of suitable lengths, and at one end with a mud-drum for receiving any deposit. The boilers are suspended from wrought iron girders resting on columns independent of the brickwork, which allows for free expansion and contraction. Each boiler is fitted with the B. & W. patent steam superheater, and patent mechanical chain grate stokers. The latter are worked by main shafts in the basement, which are operated by 30-hp electric motors. The coal is fed to the boilers from overhead bunkers capable of holding about 2400 tons, these bunkers being filled by two gravity chain bucket conveyors constructed by the Mirrlees, Watson Company, Limited, of Glasgow. Each conveyor can handle 50 tons of coal per hour.

The boilers are fed from two large storing tanks situated between the two chimneys, and which are supplied from the ordinary public water service. These tanks, which are 25 by 12 by 10 ft., each contain 18,000 gallons, and the feed-water is forced into the boilers by five electrically-driven feed pumps, made by the Mirrlees, Watson Company, Limited, operated by Bruce Peebles motors, and one steam driven feed pump by G. & J. Weir, Limited, of Glasgow. The former pumps are capable of delivering 8000 gallons per hour, against a boiler pressure of 180 lbs. per square inch, and the Weir pump is capable of delivering 16,000 gallons of water per hour against the same pressure. The fuel economizer scrapers are operated by a 10-hp British Thomson-Houston motor, each economizer heating 12,000 gallons per hour from 90 degs. up to 160 degs. All steam piping is overhead.

In the engine room four large engines and generators are installed, with space for other two, and two smaller engines, which are in line with one another and connected to each other. Two of the large engines were supplied by the E. P. Allis Company, of Milwaukee, and two by Musgrave & Sons, of Boston, Eng., while the two smaller engines are by Duncan, Stewart & Co., of Glasgow. The two Allis engines, which were supplied by R. W. Blackwell & Co., Limited, of London, are each of 4000 horse-power, with a maximum capacity of 5000 horse-power at the normal speed of 75 r. p. m., and are of the vertical, inverted, three-cylinder (one high pressure and two low pressure), compound condensing type. The diameters of the cylinders are 42 in. and 62 in., respectively, with a stroke of 5 ft., and the three cranks are set at angles of 120 degs. to give a more even turning movement. Each crankshaft is of hollow steel, supported by six bearings. The flywheel is 24 ft. in diameter, weighs 98 tons, and is built in segments, bolted together in a special way, the rim measuring 26½ by 26 in. The diameter of the shaft through the flywheel is 36 in., and the complete weight of the engine is about 700 tons. The diameters of the crank pins, beginning with the high-pressure, are 20 inches, 16 inches and 12 inches, respectively. The valve gear is of the Corliss type, and each engine is provided with an automatic control governor, and an emergency governor designed to cut off all steam should the speed increase more than 5 per cent above normal. These governors are intended to prevent the speed from ever varying more than 1½ per cent from normal, and the angular velocity 1-5 per cent during a revolution at any constant load. The engines measure, over all, 43 ft. long, 52 ft. including the generator; 35 ft. high and 24 ft. deep, while each is designed to consume 14 lbs. of steam per brake horse-power per hour.

The Musgrave engines are also of the three-cylinder, vertical, compound condensing type, of 4000 horse-power, with a maximum of 5000 horse-power, and have each one high-pressure cylinder 42 inches diameter, and two low-pressure cylinders 60 inches diameter, all having a stroke of 5 ft.

FIG. 1.—SIDE VIEW OF POWER STATION.

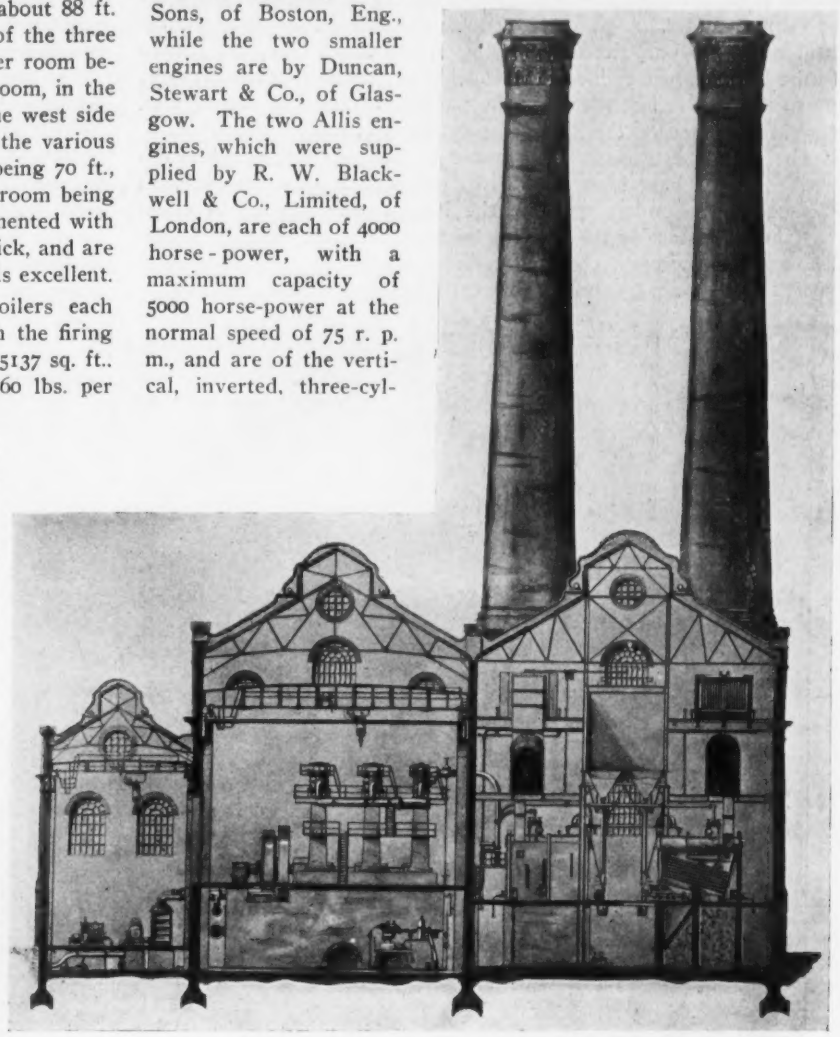


FIG. 2.—CROSS SECTION OF POWER STATION.

Corliss valves are provided with Musgrave trip motion, and are double posted, both for steam and exhaust, and at normal load the cut-off will be at four-tenths of the stroke. Two governors are provided, as in the other engines, one acting as an automatic expansion governor and the other as an emergency governor. The flywheel, of semi-steel, is built up in segments, and weighs 98 tons, the whole engine weighing 750 tons.

Each engine is fitted with a reheater or steam receiver, 3 ft. 6 inches diameter by 8 ft. long, containing 1¼-inch tubes, through which high-pressure steam from the boiler passes, reheating the exhaust steam from the high-pressure cylinder before passing into the low-pressure cylinder. A 5-inch pipe passes through the center of the reheater for the purpose of conveying steam direct from the boilers to the low-pressure cylinders, a reducing valve reducing the pressure to 50 lbs. per square inch, for the purpose of starting the engines, should they stop on the high-pressure crank centers.

The four main generators, operated by the four large engines described above, have been supplied by the British Thomson-Houston Company, of London, and are the largest yet installed in Great Britain. They are of the three-phase type, designed to develop 2500 kilowatts at a pressure of 6500 volts when running at their normal speed. They have revolving fields, each 40 poles, so that at 75 r. p. m. the periodicity is 25 cycles per second. The armature is mounted on a sliding base, so that the field coils are readily accessible. The armature core is built up of sheet iron punchings of high permeability and low hysteresis, with rectangular slots in their inner circumference. Ventilating spaces are left in the core to allow a free circulation of air through the core and around the windings. The armature winding consists of separate coils, formed and insulated before assembling, and is star connected, with two circuits per phase, and consists of 120 coils, each coil having 18 turns. The conductor consists of pressed cable, .485 by .275 inch, triple cotton, covered. The coils are held in the slots by wooden wedges, and are protected from mechanical injury by a cast-iron shield, fastened to the frame, which shield also encloses and protects the connections from coil to coil.

The pole pieces of the revolving field are built up of high permeability sheet iron, securely fastened to the steel ring of the revolving field. The winding consists of 40 coils, connected in series, and designed for an excitation voltage of 100 volts. Each coil has 43 turns of copper strip, 17 by 1⅝ inches, wound on edge. The normal excitation of the field, with full non-inductive load, requires approximately 250 amperes, the excitation current being 100-volt potential. The rise in temperature after a 12 hours' run is not to be greater than 30 degs. C in any part of the generator, when measured by the thermometer, and the machine is capable of carrying an overload of 25 per cent for two hours, or 50 per cent for 15 minutes, without injury. The weight of each generator is 202,000 lbs., or nearly 90 tons, the field weighing nearly 38 tons, and the armature and frame together almost 44 tons. The extreme diameter across the frame of the armature is 21 ft. 6 inches, the diameter of the field frame being 16 ft. 8 inches. In conclusion it should be said that the efficiency of the generators is 96 per cent at full load, 95 per cent at three-quarter load, and 93 per cent at half-load.

The generators for the auxiliary service, already referred to, as direct-connected to the Stewart engines, were also supplied by the British Thomson-Houston Company, and are four in number, and of 600-kw capacity each. Their guaranteed efficiency is 94 per cent, 93.8 per cent and 93 per cent at full load, three-quarter load and half-load, respectively. Each machine has ten poles, runs at 90 r. p. m., and weighs nearly 47 tons. These generators are suitable for operation as shunt machines, at 500 volts, no load, and full load, and as compound machines at 500 volts, no load, and 600 volts full load, and are mounted directly upon the engine shaft. The six exciters are also of B. T.-H. make, each of 50 kilowatts, and driven by a vertical Allen engine.

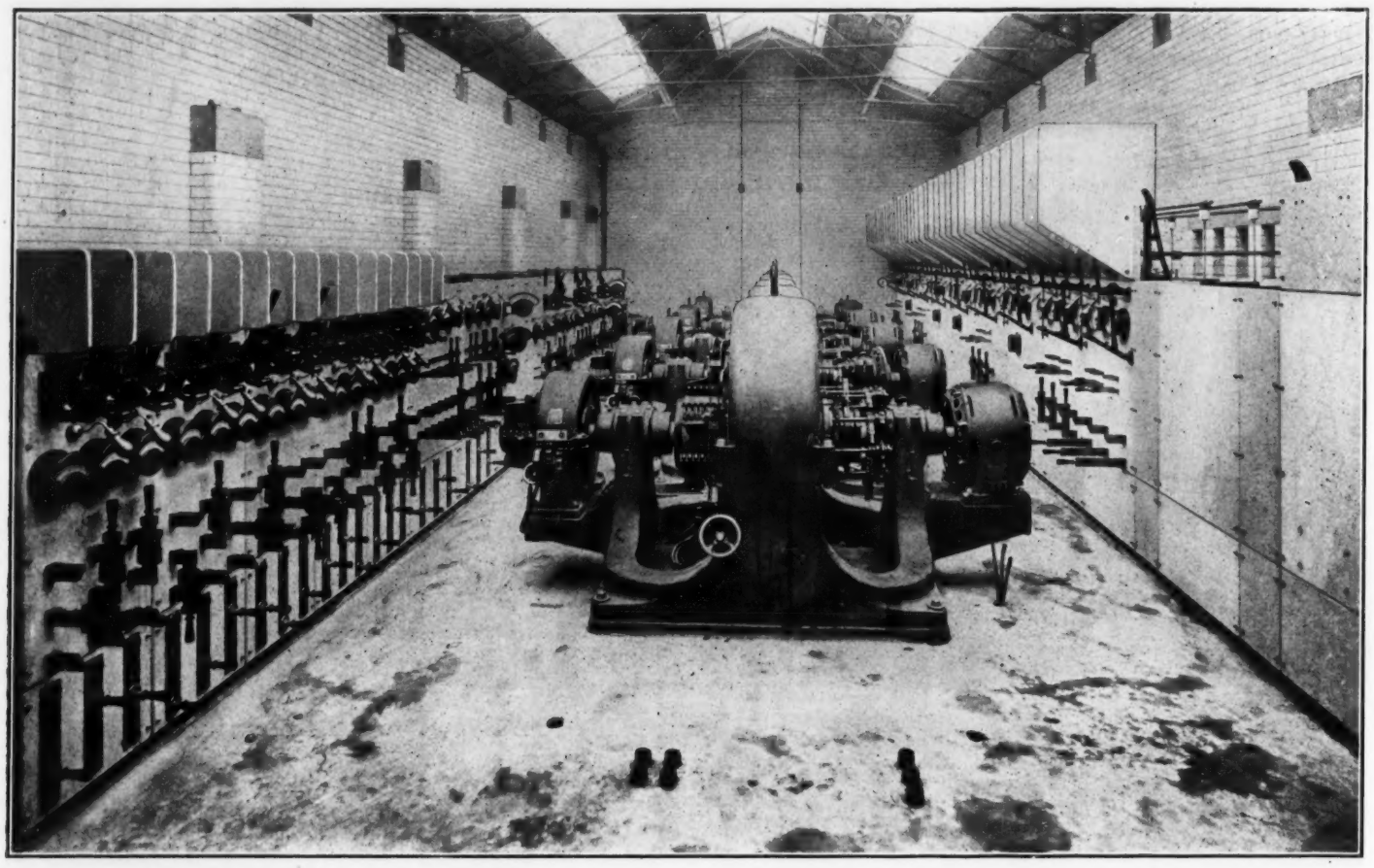


FIG 3.—INTERIOR VIEW OF WHITEVALE SUB-STATION, SHOWING ROTARY CONVERTERS.

A special feature of the Pinkston power house is the fine "auxiliary room," with its condensers, one for each main engine, and one for the two supplemental engines; four centrifugal circulating pumps driven by electric motor; four three-throw air pumps, also driven by Bruce Peebles motor, and steam-driven feed pumps for the boilers.

The British Westinghouse Electric Company, of London, built the fine switchboard, which comprises about 1200 sq. ft. of marble, provides for the generators, inter-connecting circuits, feeder circuits, and also the exciter circuits. The generator panels, one to each main generator, each contain a main three-phase high-tension switch, three ammeters, a voltmeter, a field ammeter, two indicating wattmeters, a three-phase integrating wattmeter; a voltmeter plug, and a double-throw field switch with discharge resistance. All the instruments, which are of the Westinghouse standard type, are worked on the transformer system, thus preventing the working parts from being

subjected to a high pressure. The feeder panels, of which there are 20, are arranged in five groups in the rear of the generator panels, each group supplying one of the five sub-stations. The inter-connecting panels provide an easy means of operating any of the generators in parallel with the others, or separately, as may be required. The exciter panels are situated between the generator and inter-connector panels, and require no description, their function being quite simple. All the bus-bars and the high-tension connecting bars consist of bare copper tube, supported on porcelain insulators, 10 ft. above the gallery floor level, so that liability to accident is minimized. The switchboard for the auxiliary engines is situated on the main floor of the engine room, immediately in front of the exciters, and underneath the high-tension switchboard gallery. This switchboard deals with the 500-volt circuits from the auxiliary generators, and makes provision for the various lighting and power circuits in the building, and outside low-tension circuits to the various depots and sub-stations. All the wiring in the power house is underground in specially provided ducts, and consists of paper insulated, lead-covered cables supplied by the National Conduit & Cable Company.

The British Westinghouse Electric Company also supplied all the apparatus for the sub-stations to which current is distributed by cables and cement-lined iron pipe furnished by the National Conduit & Cable Company. A description of the sub-station at Whitevale, illustrated, will suffice for all five of them. In this sub-station are five units, each consisting of three transformers and one rotary con-

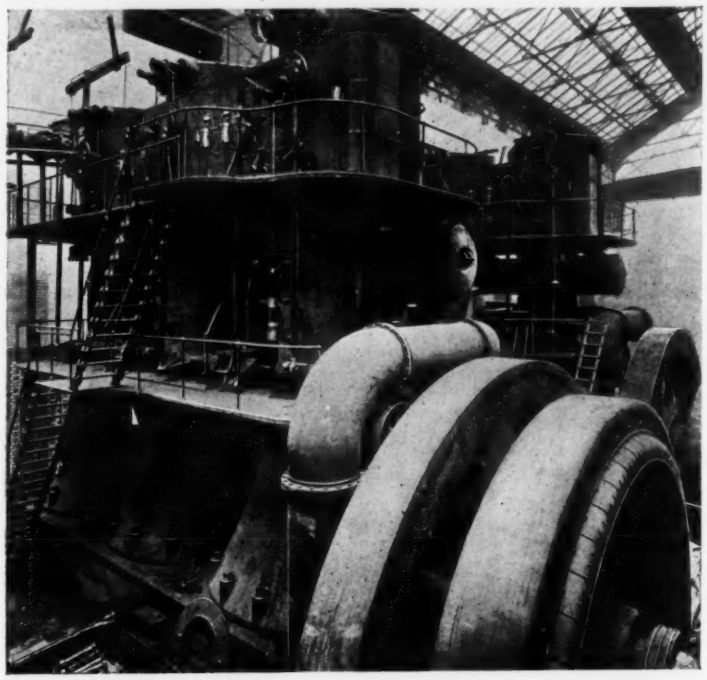


FIG. 4.—GENERATORS AND ALLIS ENGINES AT POWER HOUSE.

verter. Each set of three transformers, feeding the rotaries, is completely isolated from the rest of the plant by means of a brick chamber, in which it is set. Each transformer has a capacity of 200 kilowatts, and transforms the 6500-volt current from the main generating station to 310, 330 or of 350 volts on the secondary side, as may be desired. The rotary converters, one to three transformers, are each of 500-kw capacity, and are arranged to over-compound from 500 volts at no-load to 550 volts at full load. They are of the six-pole type, and run at 500 r. p. m., the cycles per second being 25, as in the main generators. The efficiency of the transformers is guaranteed to be 97½ per cent at full load and 97 per cent at half-load, while the rotary converters are guaranteed to have an efficiency of 95 per cent at full load, 94 per cent at three-quarter load and 92½ per cent at half-load. A three-phase induction motor is rigidly connected on the shaft of each rotary converter, for starting up and synchronizing the converter, and, in addition, there is also a continuous-current booster on the other end of the shaft for the usual minimizing of the fall of potential, owing to the resistance of the rails. The switchboards are situated on opposite sides of the room, the high tension on the one side and the continuous-current and feeder panels on the other.

The municipality has its own car works, and has built and equipped over 300 cars, all double deckers, besides purchasing some car bodies outside. The trucks are of Brill make. The electrical equipment of the cars is, for the most part, of the Westinghouse type, and consists of two motors wound for 500 volts, two series-parallel controllers, resistances, fuse block, main motor, current switch, automatic motor switch and lightning arrester. Each motor is capable of exerting 1600 lbs. horizontal effort at a speed of 7½ miles per hour. There are in all 14 car houses situated in convenient localities throughout the city. The rails weigh 100 lbs. per yard, with a track gauge of 4 ft. 7½ inches. The bonds are No. 0000, supplied by R. W. Blackwell & Co. Nearly all of the trolley wire is supported by span wire and is No. 00 B. & S., with galvanized steel guard wire. Two sizes of steel side pole are in use. The overhead construction was done by Macartney, McElroy & Co., of London and New York.

British Pacific Cable.

A Canadian correspondent states that a deadlock has arisen between the Government of New South Wales and the Dominion Government over the proposed all-British Pacific cable scheme. The Australian colony has granted important concessions to the Eastern Extension Telegraph Company, the competing line. To this Canada strenuously objects, claiming it to be a breach of good faith. The question was referred to the law officers of the crown in Canada, who reported that the action of New South Wales was clearly detrimental to the interests of the Dominion. The British law officers have also reported upon the subject, but in a directly opposite sense, thus causing friction between England and Canada as well. In view of the evident gravity of the situation, and the likelihood of a collapse of the whole cable scheme, Sir Wilfrid Laurier, upon the second reading of the cable bill shortly before the prorogation of Dominion Parliament, reviewed the condition of affairs in respect to the cable project and added a proviso to the cable bill that it shall not go into effect except upon an Order-in-Council. This means that, so far as Canada is concerned, the cable is hung up instead of laid down.

Niagara Falls Power Notes

Penstock No. 3, of the Niagara Falls Hydraulic & Manufacturing Company, was shut off at 8.05 p. m. May 14, 1901, cutting off six dynamos, the object being to prevent the wearing away of the rocks at the outlet of the tail-race into the river. This wearing away had become a serious matter, occurring very near the power house, and retaining walls having crumbled away, as has taken place before in other tail-races.

The device to overcome future destruction consists of a number of pieces of boiler iron, riveted together to form the bottom of the tail-race. There are upright side extensions also of iron to preserve the side walls. At the end toward the river there is a slight upward curve in the iron plate, to throw the water upward and thus prevent further undermining.

Electricity in Nova Scotian Steel Works.

According to the various descriptions given of the great plant of Canada's new iron and steel industries at Sydney, Cape Breton, in the province of Nova Scotia, where the cheapest iron and steel in the world are now being made, electricity plays an important part in the labor-saving operations of this vast industrial undertaking. Electricity, as a motive power, is used in every conceivable way all over the steel plant. In the winter season, when ore and limestone are used from the stock piles, they are gathered up with scoop buckets worked from a trolley traveler, which delivers its load, two or three tons at a lift, into the bins by the furnaces. All the scooping and carrying is done by electric power. Three of the electrically worked travelers serve four blast furnaces, up the sides of which the loaded buckets are hauled to a height of 85 ft., by electric power also, and dumped automatically into the furnaces. Gravitation and electricity are the motive powers, and no men are seen toiling with shovels and wheelbarrows and laboring amid smoke and fumes, and there is no commotion about all this outside work. Nothing in the great plant bears an earlier date than 1900. Much of it will bear the date of 1901. It is typical of the latest and best that experience and practice of the great steel plants of Pennsylvania, Ohio and Illinois have yet evolved, and it is only necessary to spend a couple of hours, it is said, about the first of the Sydney furnaces which have been put into blast, to realize that the design of these modern plants, chiefly by the use of gravitation and electricity, have done away with nearly all of the hard exposing and brutalizing labor, and with much, if not all, of the smoke and fume which an Englishman associates with the making of pig metal at furnaces in Lancashire and Yorkshire.

Determination of the Angular Displacement of Prime Movers.

BY LIONEL FLEISCHMANN, PH.D.

IT is a well established fact that in parallel operation of alternators the utmost care must be taken in prescribing the admissible maximum angular displacement. But to my knowledge no accurate method has been developed which permits of its ready calculation from the velocity diagram of the prime mover.

Let us consider Fig. 1 as being the velocity diagram of a steam engine. The method for obtaining this from the torque diagram is well known. Let a represent at any moment the arc traveled by a point of the flywheel at the distance of unity from the center of rotation, ω its instantaneous velocity, the angle 2π corresponding to one complete revolution. If t represents the time counted from the moment of coincidence of the fixed point of the flywheel with a fixed point in space, the following fundamental equation of motion holds good:

$$\omega = \frac{da}{dt} \qquad (1)$$

which may also be written:

$$dt = \frac{da}{\omega} \qquad (2)$$

If the time of one revolution of the flywheel is T seconds, its mean angular velocity will be $\frac{2\pi}{T}$. Now, assume a point revolving with this mean and constant velocity. While the flywheel rotating with a variable speed describes an angle da in the time dt, the point revolving with this constant angular velocity has passed over an arc

$$da^1 = \frac{2\pi}{T}\, dt; \qquad (3)$$

or substituting from equation (2) the value $\frac{da}{\omega}$ for dt, we arrive at

$$da^1 = \frac{2\pi}{T}\, \frac{da}{\omega}$$

By a simple process of integration we find the total distance a^1 traveled by the point with constant velocity during the time the flywheel has described an angle a to be

$$a^1 = \int_0^a \frac{2\pi}{T}\, \frac{da}{\omega},$$

and the angular displacement is given by the difference

$$\triangle a = a - a^1 = a - \int_0^a \frac{2\pi}{T}\, \frac{da}{\omega} \qquad (4)$$

It is now left to find for which values of a this expression reaches its maximum or minimum. In order to determine this we have to differentiate $\triangle a$ with respect to a:

$$\frac{d \triangle a}{da} = 1 - \frac{2\pi}{T}\, \frac{1}{\omega}; \qquad (5)$$

equating this to zero gives the value

$$\omega = \frac{2\pi}{T} \qquad (6)$$

This equation shows the angular displacement to reach its maximum or minimum—that is, the point revolving with constant velocity—has its greatest lead or lag in reference to the point moving with variable speed each time when the variable speed equals the mean constant speed.

For the solution of the integral given in equation (4) it is necessary to know ω as a function of a. In the most general case a will be given by a series of Fourier and the calculation would be rather tedious. But there fortunately exists a very simple graphical method for obtaining this value. Let us write the integral $\int \frac{da}{\omega}$ in the form, $\int da\, \frac{(1)}{\omega}$. Then we see at once that it may be regarded as the area of a curve having a as abscissae and $\frac{1}{\omega}$ as ordinates, whence it follows that by simply determining the areas marked in Fig. 2, we also obtain values proportional to the maximum angular displacement.

In order to find the constant with which the areas have to be multiplied we only need to determine the area of the rectangle having 2π as abscissae and $\frac{T}{2\pi}$ as ordinate; calling its area F the constant will be $\frac{2\pi}{F}$.

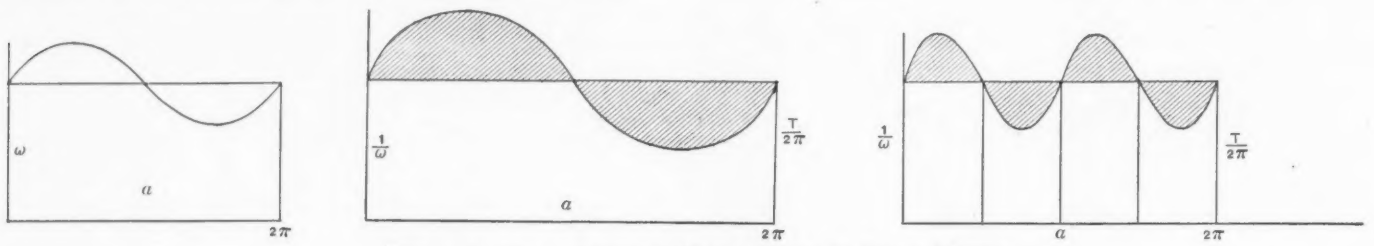
This graphic representation also shows very plainly why generally an engine having a number of impulses (each impulse corresponding to a maximum in the speed curve) is preferable to one with few. Fig. 3 corresponds to a velocity curve having the same maximum, minimum and average speed, but possessing two impulses instead of one.

We see at a glance that the areas representing lag or lead of the flywheel, whether they are above or below the line having $\frac{T}{2\pi}$ as ordinate, are smaller than in Fig. 2. In case the velocity diagram is represented by a saw-toothed line having together n maxima and minima, as shown in Fig. 4, it is possible to calculate the maximum angular displacement.

The velocity ω as a function of a is expressed by

$$\omega = \omega_0 + \frac{\omega_1 - \omega_0}{\frac{2\pi}{n}}\, a \text{ and } {}_0 \leqq a \leqq \frac{2\pi}{n}$$

$$\omega = \omega_0 + \frac{\omega_1 - \omega_0}{\frac{2\pi}{n}} \left\{ \frac{4\pi}{n} - a \right\} \text{ and } \frac{2\pi}{n} \leqq a \leqq \frac{4\pi}{n}$$



FIGS. 1, 2 AND 3.—ANGULAR DISPLACEMENT OF PRIME MOVERS.

inserting these values in the equation for T,

$$T = \int_0^{2\pi} \frac{da}{\omega}$$

$$T = \frac{n}{2} \left\{ \int_0^{\frac{2\pi}{n}} \frac{da}{\omega_0 + (\omega_1 - \omega_0)\, \frac{n\,a}{2\pi}} + \int_{\frac{2\pi}{n}}^{\frac{4\pi}{n}} \frac{da}{(2\omega_1 - \omega_0) - n(\omega_1 - \omega_0)\, \frac{a}{2\pi}} \right\}$$

$$T = \frac{2\pi}{\omega_1 - \omega_0} \log \frac{\omega_1}{\omega_0}$$

The average velocity equals $\frac{2\pi}{T}$, and

$$\omega_m = \frac{\omega_1 - \omega_0}{\log \frac{\omega_1}{\omega_0}}$$

This is rather a remarkable result, for it has always been the rule to call the expression $\frac{\omega_1 + \omega_0}{2}$ the average speed, but this is only justified in so long as we regard the speed in relation to the position

of the flywheel or of the piston stroke. Practically, the numerical values of the two average speeds will be the same. Log $\frac{\omega_1}{\omega_0}$ can be written thus:

$$\log \frac{(\omega_1)}{\omega_0} = 2\left[\frac{\omega_1 - \omega_0}{\omega_1 + \omega_0} + \frac{1}{3}\left(\frac{\omega_1 - \omega_0}{\omega_1 + \omega_0}\right)^3 \ldots\ldots\right]$$

$\frac{\omega_1 - \omega_0}{\omega_1 + \omega_0}$ has generally a value lying between $\frac{1}{150}$ and $\frac{1}{300}$, so all higher powers can be neglected, and we may write

$$\omega_m = \frac{\omega_1 - \omega_0}{2(\omega_1 - \omega_0)}\omega_1 + \omega_0 = \frac{\omega_1 + \omega_0}{2}$$

We had to determine ω_m in order to fix the limits of the integral

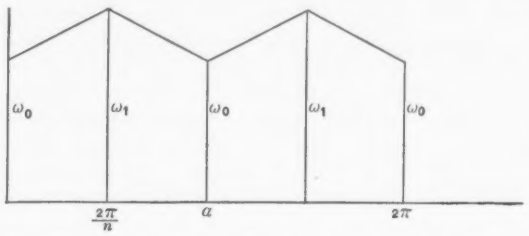


FIG. 4.—ANGULAR DISPLACEMENT OF PRIME MOVERS.

in the expression for $\triangle a$ in equation (4). We will not carry out the intermediate steps, but only give the final result,

$$\triangle a = \pm \frac{2\pi}{n}\left\{\frac{\omega_m - \omega_0}{\omega_1 - \omega_0} - \frac{\log \omega_m - \log \omega_0}{\log \omega_1 - \log \omega_0}\right\}$$

To express the angular displacement in electrical degrees the value of $\triangle a$ has to be multiplied by $\frac{p\, a\, 180}{\pi}$, where $2p$ is the total number of poles of the alternator.

In conclusion, we arrive at the result that the angular displacement is not only dependent upon the maximum change in speed, but also determined by the general character of the velocity curve.

Central Station Load Curves from Canada.

The accompanying load curves from a large city central station are particularly interesting as showing the result of a policy whereby motor contracts are so made that during the winter months, large

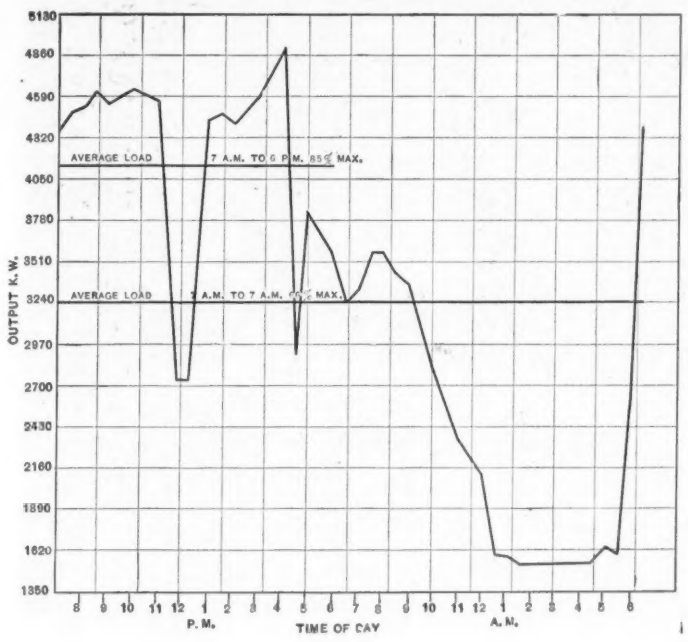


FIG. 1.—OUTPUT CURVE, DEC. 28.

blocks of power are dropped out of service at the time of peak lighting load. The extent to which this has so far been accomplished is clearly shown by (Fig. 1) giving the curve for Dec. 28, from which it will be seen that the average percentage of maximum from 7 a. m. to 6 p. m. would have been far below the 85 per cent shown in the curve if it had been required to meet the peak demands of the lighting load at the same time the station was called upon to supply the motor load.

The curve of Fig. 2 is for April 10, and shows the load from the same station for an average spring day with the motor load continuing to be supplied up to 6 p. m. From this curve it will be noted that the high percentage for average load of 94 per cent of the

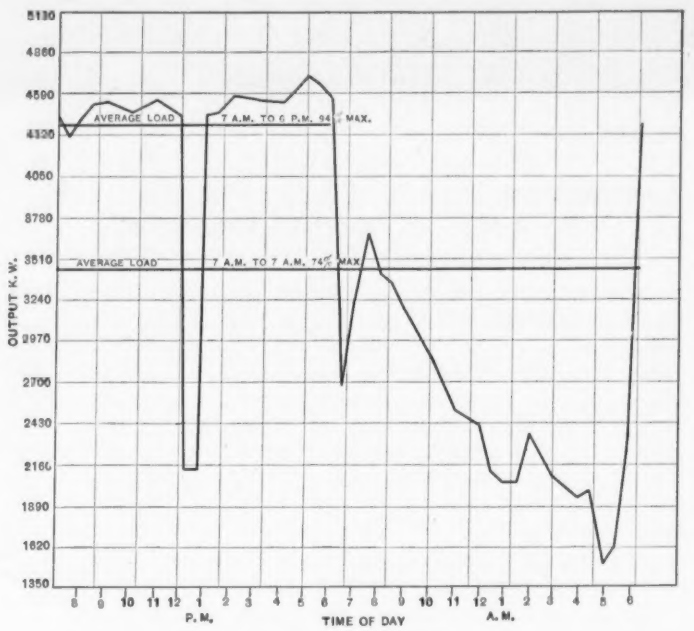


FIG. 2.—OUTPUT CURVE, APRIL 10.

maximum has been reached for the period from 7 a. m. to 6 p. m. This curve, of course, clearly indicates that the lighting demand was of little consequence for that day.

The difference in the curve for the noon hours for Dec. 28 and April 10 is due to a peculiar local condition caused by the different hours of stopping and starting of large mills, the irregularity being the direct result of the early afternoon closing down. The curves are for a combined motor and lighting service from one general system, all generators being operated in parallel.

Independent Telephonists Want Uniform Rates.

It is given out, on good authority, that the independent telephone men of Indiana will be called together at an early day to take action toward establishing a uniform rate for service in the farming districts. The independents assert that they have taken the initiative in this important development of the telephone business in Indiana, and while there is uniformity of rates in the cities and towns, and an understanding relative to long-distance connections, there has been much confusion as to what shall be charged in the country districts. Thousands of farm residences have been connected with the city and town exchanges, and the demand for telephones among the farmers is increasing rapidly. The Hon. Hugh Dougherty, of Bluffton, who has been prominently identified with the organization of the independents and a heavy stockholder says the meeting will be called. The men who have had a hand in shaping the progress of the independent companies have decided that something should be done at once toward bringing about uniform rates. The farmers are anxious to have telephone connection with the cities and towns of their localities, but at this time there is no uniformity among the independents as to what rate shall be charged.

The Central Union Company has recently entered the rural districts in competition with the independents, and in some places, it is said, it is charging only 50 cents a month for each telephone.

Western Union in the New Stock Exchange, N. Y.

The Western Union Telegraph Company has leased accommodations in the new Stock Exchange building for 21 years at $25,000 a year.

Copyright, Oscar A. Simon. *THE PAN-AMERICAN.*

Water Rheostat for a 3,750 k. w. Circuit at 11,000 Volts at the Pan-American Exposition.

IN an obscure corner of the grounds in a rough shed is one of the most novel and daring electrical engineering features of the Pan-American Exposition. It is the rheostat for bringing gradually up to candle-power the 200,000 8-cp incandescent lamps used in the decorative lighting. Both the apparatus and the results are novelties in the electrical engineering world. Never before has it been attempted to bring up slowly or gradually reduce in candle-power such an immense body of lights simultaneously nor has the control of such a large quantity of energy at such a high voltage ever been attempted by a rheostat.

The big rheostat is located at the western edge of the grounds at the point where the 11,000-volt Niagara transmission line enters. The special Niagara transmission line leaves the main 22,000-volt Niagara-Buffalo transmission line at the sub-station at Ontario Street, where transformers reduce from 22,000 to 11,000 volts. The transmission line supplying the Exposition consists of two three-phase circuits of No. 00 copper on Imperial porcelain insulators. The rheostat house, which is on stilts about 15 ft. high, near the northwest corner of the grounds, is shown in Fig. 1. It contains three tanks of water, one for each leg of the circuit. These tanks are 10 ft. long, 3 ft. wide and 3 ft. deep. They are all mounted on porcelain insulators, such as are used on the line. Into this tank three cast-iron plates operate to vary the resistance in circuit. These plates are approximately the shape shown in Fig. 2. They are of cast iron, 8 ft. long, ¾ inch thick, and are pivoted at the point indicated, so that they describe the arc of a circle while being lowered into the water. When fully in the water the tip strikes a submerged clip or switch jaw, which short circuits the rheostat. The increase of candle-power of the lamps from the dullest red to full brilliancy is

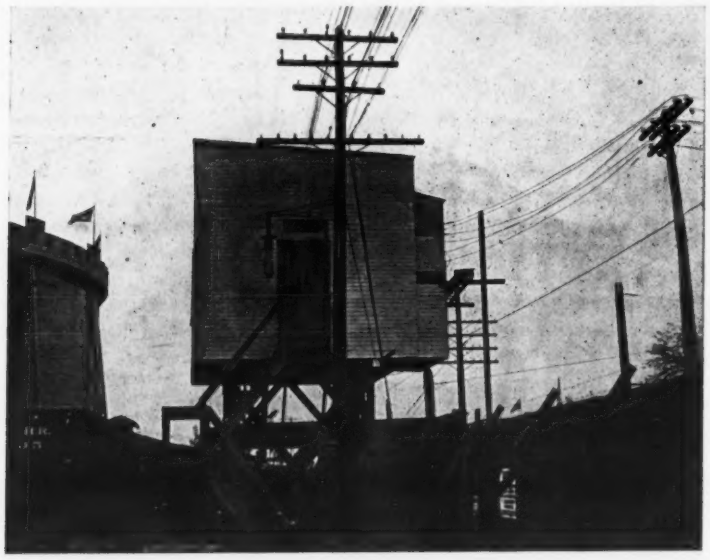


FIG. 1.—HOUSE ON STILTS FOR WATER RHEOSTAT.

very steady, except that there is a sudden rise just before the plate strikes the submerged clip. The plates are lowered simultaneously by an electric motor working on a worm gear. The motor can be controlled from a distance if desired, but is usually started and stopped by a man in the rheostat house. In lighting up the lamps are brought up to full candle-power in 45 seconds. In shutting down 75 seconds is consumed. No accurate tests have been made on the amount of energy consumed by the rheostat. Judging from the appearance of the lamps the voltage at the start is not over 20 per cent of the full voltage. Assuming that the 200,000 25-watt lamps take one-fifth their normal current and voltage at the start the rheostat takes 800 kilowatts. Of course, the current is sufficient to make the water in the tanks boil voilently. The lip at the pivot end of the cast

FIG. 2.—CAST-IRON PLATE OF RHEOSTAT.

iron rheostat plate is always under water, and the circuit is broken by the main oil switch in the Electricity Building. It was found entirely impracticable to try to break the arc at the rheostat or even to allow the plate to come the least out of the water, as the resultant arc would stream all over the neighborhood. The rheostat is used only for turning on the lights at the grand illumination at 8 p. m. and for turning them off for the night several hours later.

The scenic effect is all that was anticipated and more. The thrill of the spectator who, for the first time, stands in the main area at dusk in the evening and sees that immense mass of illumination rise

FIG. 3.—"GLOW" EFFECT.

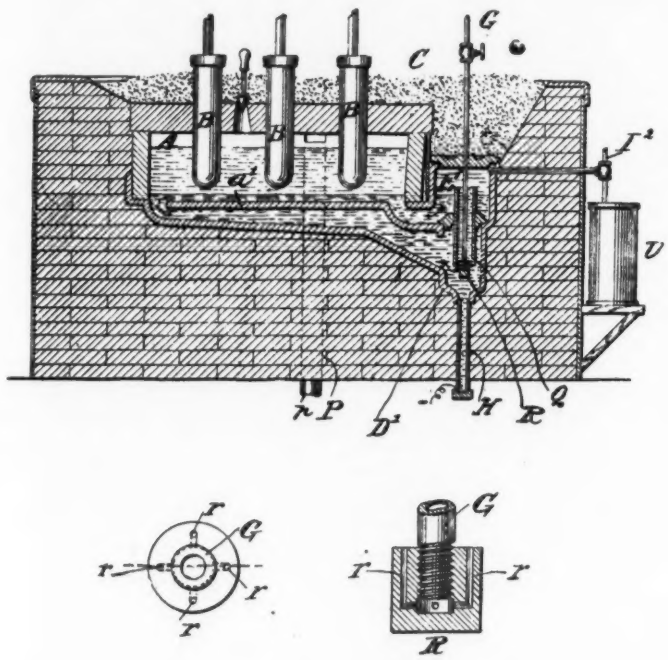
from a dull red to full brilliancy must be felt to be appreciated. First comes the dull red glow from the lights nearest the observer and the distant points at which the lights are most thickly concentrated. As the lamps increase in candle-power the more scattered lights become visible until the whole is a mass of glow. This effect is best seen

on the sides of the electric tower, where the number of lights is greatest in the middle of circular areas, and gradually diminishes towards the circumferences of these areas. To an observer at a distance the light is seen first at the center and gradually spreads toward the circumferences as the candle-power increases. The aims of Mr. Stieringer to produce a glow effect and have areas rather than points of light have succeeded admirably. Especially is this true at a distance of half a mile from the grounds when the identity of individual lamps almost entirely disappears, and the tower seems to be only a glowing pillar with some prominent parts glowing more brightly than others. The "glow" effect is also shown well by the accompanying bit from the electric tower (Fig. 3).

Caustic Soda from Fused Electrolytes.

The Castner alkali process, employing an aqueous solution of sodium chloride as electrolyte, a circulating cathode of mercury, and water as oxidant for the amalgam, forms the basis of a vast manufacturing industry in this country and abroad. What advantages would follow and what difficulties would arise, if the whole procedure were moved upward one step in respect to temperature, and molten salt substituted for the aqueous electrolyte, fused lead for the mercury cathode, and steam for the oxidant? The suggestion is due to Castner himself, its development to Vautin, Hulin and Borchers, and its industrial perfection to Acker. The results at the Niagara factory of the Acker Process Company, but now beginning operations, will be awaited with interest.

Castner's suggestion never went further than a mental extension of his well-known method: "The same principle may be applied to the electrolysis of fused salts, using a molten metal, such as lead, tin or the like, or an alloy of various metals in place of mercury." Vautin and Hulin encountered the difficulties which arise from the tendency of the separated sodium to collect in the form of globules and reduce the fused salt to a sub-chloride, from the rapid depreciation of the fusion vessels, and from the indiscriminate chemical activity of hot chlorine. Of these difficulties the first and most serious was solved by Hulin by the expedient of electrolyzing, instead of pure fused sodium chloride, a fused mixture of lead and sodium chlorides pro-



SECTION VIEW OF CELL.

portioned to yield a lead-sodium alloy of the richness required, and maintained of the proper composition by shunting a portion of the current through an anode of melted lead. This procedure is open to the objection that it involves the electrolytic deposition of the lead as well as of the sodium, and therefore an additional expenditure of current.

Acker's solution of the first-mentioned difficulty consists in causing the molten lead cathode to flow rapidly and in a thin film beneath the anodes, and the striking ingenuity of the process lies in effecting the circulation by means of a jet of steam, injected into the molten lead, and serving not only to establish a circulation and to conserve the heat of the furnace by the oxidation of sodium within its structure, but also to produce as a result of the oxidation, pure molten caustic which may be tapped off continuously.

The accompanying figure discloses a form of cell employed, consisting of an elongated vessel *A*, having a bottom of steel, side walls of a basic material as magnesia which is resistant to the fused electrolyte, and divided horizontally by a removable steel diaphragm *a'*. The upper and lower compartments so formed communicate at either end, on the left of the figure through a simple slot, and on the right through an upright open-ended tube *Q* of metal, near the bottom of which is the injector *G, R, r,* for steam, constructed as shown in detail in the smaller figures. Anodes *B* of graphite project through the cover into close proximity to the thin layer of lead which covers the diaphragm. A body of lead fills the entire bottom of the vessel and floods the metal partition, the cathode connection therewith being made through a pipe *H* communicating with the injector-well *D'*. A mass of dry salt *C* heaped over the furnace and around the anodes fulfills the triple function of heat retainer, gas seal, and supply reservoir.

In operation, and as a result of the injection of steam, the tube *Q* becomes filled with an upwardly moving column of mingled lead, caustic and hydrogen. In the chamber *E* these constituents are parted by stratification, the impoverished alloy flowing under an inverted bridge wall to re-enter the electrolytic chamber, and the liquid caustic soda, nearly or quite anhydrous, passing to the drum *U*. Hydrogen escaping at I^2 may be employed as desired; a slight modification in the form of the furnace permits its use, burned with air, for preliminarily melting the salt. Chlorine is drawn off by conduits *P, p,* and applied to the manufacture of bleaching powder.

The capabilities of the cell are as yet a matter for conjecture. In general fused bath processes have been found to work with relatively low current efficiency, but by reason of the high current densities which may be employed, to yield an enormous relative output—the return of caustic from a given cathode area often exceeding that from a mercury cell thirtyfold. The new cell will be found not less efficient than its predecessors in the latter respect, and it may be that the rapid movement of the cathode will render it possible to use current densities greatly superior to those heretofore available, and herein lies its hope of successful competition with the earlier types.

Automobilism in the United States.

The Automobile Club of America has decided to organize an annual road race, subject to the approval of the local authorities wherever the course is chosen. The sweepstakes will probably amount to $5,000. It will be an international race, open to competitors from all over the world. The first race will probably be over the Buffalo-Erie course about the middle of September. The following resolution adopted by the Board of Governors May 20 gives particulars:

RESOLVED, That the Automobile Club of America organize, subject to the consent of the local authorities, an annual road race, to be known as "The Automobile Club of America Sweepstakes," the course to be chosen and the date fixed by the committee on races, to be properly policed and guarded, and to be not over 100 miles nor less than 50 miles in length; that it be open to cars carrying two persons; that the entry fee be $100 for each vehicle, and $50 additional for starters.

RESOLVED, That the winner receive 80 per cent of the stakes, the second 15 per cent and the third 5 per cent.

RESOLVED, That the Automobile Club of America subscribe $1,000 toward the sweepstakes.

RESOLVED, That subscriptions to the above sweepstakes be asked for from members of the club.

THE MILE RECORD.

RESOLVED, That the Automobile Club of America organize, subject to the consent of the local authorities, an annual race for the mile record, the date and the course to be selected by the committee on races, the course to be properly policed and guarded. Entries to be made for steam, gasoline and electric carriages in separate classes; that the entrance fee be $10; that the club appropriate $600 for the purchase of three cups, one for the winner in each class.

A Fuel Gas Plant for a Model Isolated Hospital in England.

WALTHAMSTOW is a town situated just outside of London to the northeast. It has a population of over 100,000, and its administration is attended to by a district council. The most recently completed scheme carried out by the council has been the providing of a completely equipped modern hosiptal, where patients suffering from infectious diseases may be isolated, and at the same time receive the best of attention and care. The hospital is situated at Shingford on the borders of the Epping Forest, about 20 acres of land having been purchased there by the council in 1894. Some five and a half acres of this land have been enclosed, and set apart for the present hospital and its extensions, sure to be required at no very distant date, since its present capacity, 46 patients, is only about half of what is usually considered necessary for a population the size of that of Walthamstow, and since this population is increasing at a very rapid rate.

The hospital buildings are six in number, and all are one story high, with the exception of the administrative building, which is of two stories. These are four pavilions for the accommodation of patients, three containing 14 beds each, and one containng four beds. The other building comprises the engineroom, laundry, etc. There is also a porter's lodge of picturesque appearance at the entrance gate to the grounds. The buildings are of red brick, the interior walls of the pavilions are finished with cement and all corners and angles are rounded to facilitate perfect cleaning. Partitions and floorings are of polished teak. The two-story administrative building is arranged for the accommodation of the resident medical officer, matron, nurses and domestic staff.

The building set apart for what might be termed the engineering work of the hospital is of special interest. In it is the gas and electrical installation, and there are departments fitted with the most modern machinery for laundry work and for disinfecting. The most interesting feature of this entire plant is that which pertains to the manufacture of gas and the production of power therefrom. The gas producing plant is in duplicate, so that any portion of it may be shut down for repairs or cleaning without interfering with the operation of the hospital. This duplicate feature is not essential in ordinary power plants operating 10 hours a day.

Each gas producing unit consists of one Dowson generator, one small vertical boiler, one hydraulic washer or coke scrubber, and one sawdust scrubber. As is well known, "Dowson Gas" is gas made by the passage of air and steam through a fuel bed. Such gas will vary from 120 to 150 B. T. U. per cu. ft., and it is admirably adapted for use in gas engines.

In this plant anthracite pea coal is used. Crushed coke will also give results equally good. Gas from such material contains little or no volatile matter, and is easily scrubbed and purified. The scrubber is filled with coke and a water spray is provided at the top of the scrubber. As the gas contains practically no tar, the coke does not need to be renewed, except at long intervals. The sawdust scrubber serves to catch entrained dust and fine ash, which might be carried over with the gas. Excelsior serves equally well and is cheap, and easily replaced in the scrubber. Both of these scrubbers are provided with suitable hand-holes and cleaning doors so that the operation in refilling them is a very simple matter. The gas holder is 24 ft. in diameter and 10 ft. deep, having a capacity of 4524 cu. ft. This holder serves to maintain a uniform pressure of gas to the engine and throughout the piping system, regardless of the speed at which the engine may be working.

Inasmuch as the gas leaving the producer is of low calorific value it has been found advisable to carburet it for purposes other than the generation of power. No economy would be gained by using the carburetted gas in the gas engine; in fact, the gas engines operate upon gas of low calorific value fully as well as they do upon gas which has been carburetted. An additional valuable feature about the carburetting of gas is that the gas acquires an unmistakable and characteristic odor. This carburetted gas is piped to each of the buildings above mentioned and is used for heating and domestic purposes.

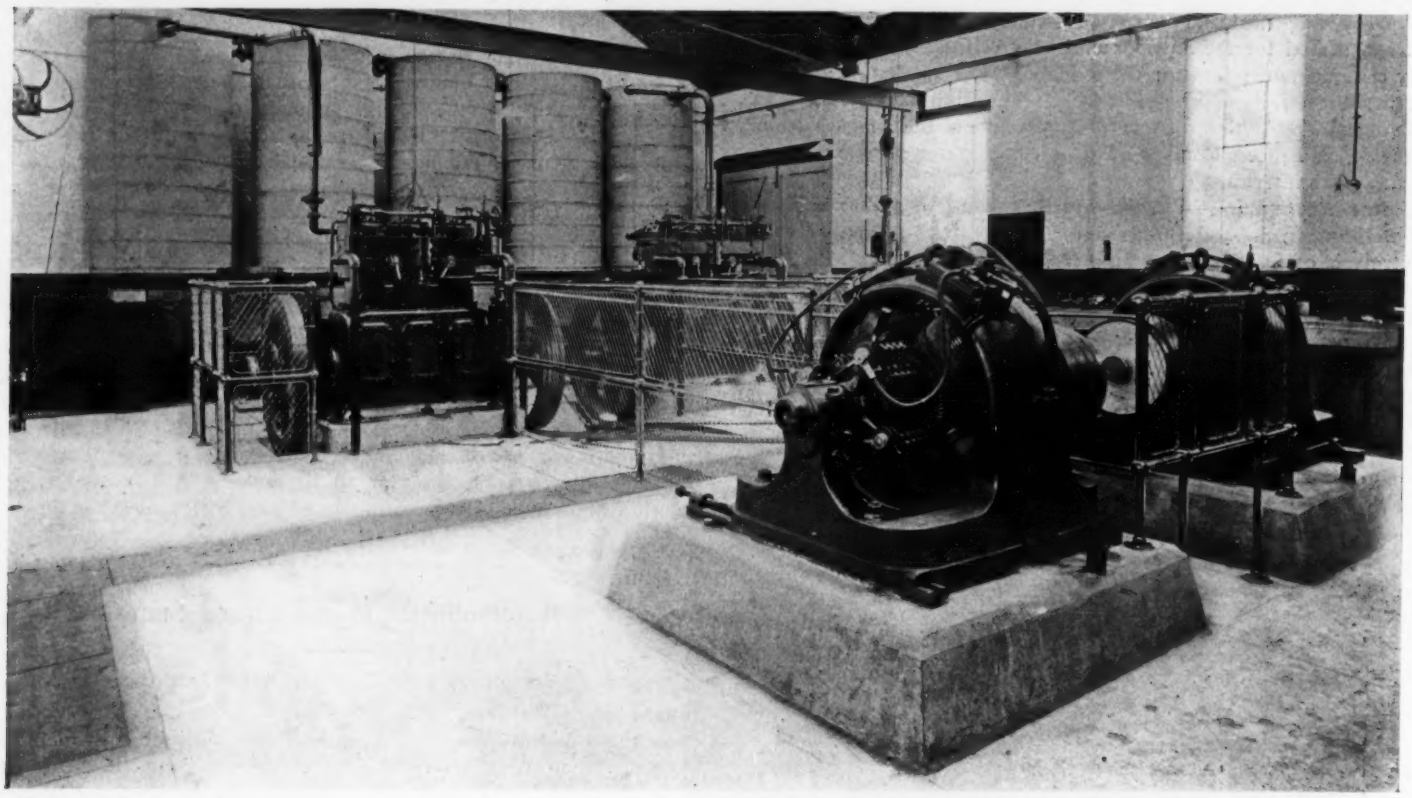


FIG. 1.—GENERAL VIEW OF THE POWER PLANT.

The culinary arrangements consist of a large roaster whose inside measurements are 4 ft. 6 in. by 2 ft. 9 in. by 2 ft. deep, and a large cooking range containing three ovens. The gas is also used in portable gas furnaces. It will thus be seen that the gas supply is used for practically all power, heating and cooking purposes in connection with the hospital. Exact data as to the efficiency of the plant are not available, but it is obvious that a central station manufacturing gas with the smallest amount of labor and distributing it over the entire plant with all the above-mentioned uses, must possess a decided economy over a system in which coal would be burned direct at various points with the necessary accompaniment of fuel loss, increased labor and the nuisance of ash and smoke.

Two Westinghouse three-cylinder gas engines are supplied from the 4-inch gas-holder main. These engines are of high-speed, and are among the most effective gas engines ever introduced. They are practically noiseless in operation, have a very high running ef-

ficiency, and fine speed regulation at widely varying loads. Each of these engines develops 28 b. h. p., and is coupled by belt to a direct-current compound-wound electric generator. The lighting of all the buildings is supplied by these generating sets. A battery of about 50 cells is placed across the supply circuit, and serves as a relay and as a regulator of the supply circuit pressure. With the battery across

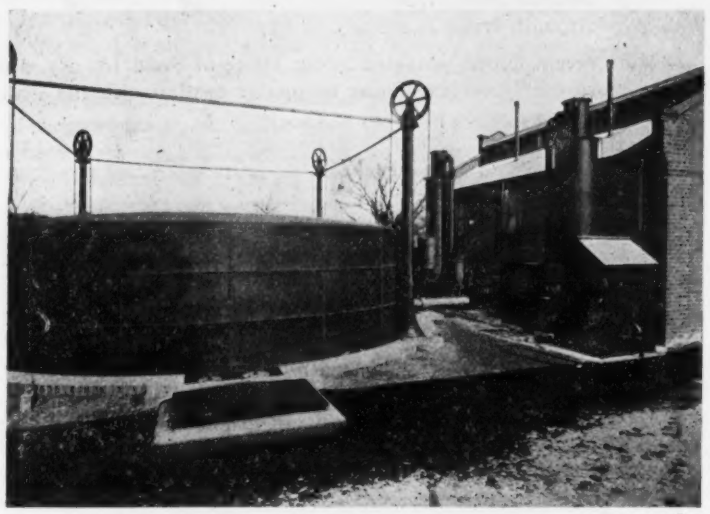


FIG. 2.—GAS HOLDER AND PRODUCER HOUSE.

the mains, the series turns of the generator fields are cut out of circuit.

The electric cables between the buildings are laid underground, being of the lead-covered type drawn into iron pipes. The mains supplying each building are duplicated so as to preserve the supply in the event of a breakdown on one main. Each building is provided with a main distributing board at which the lighting circuits

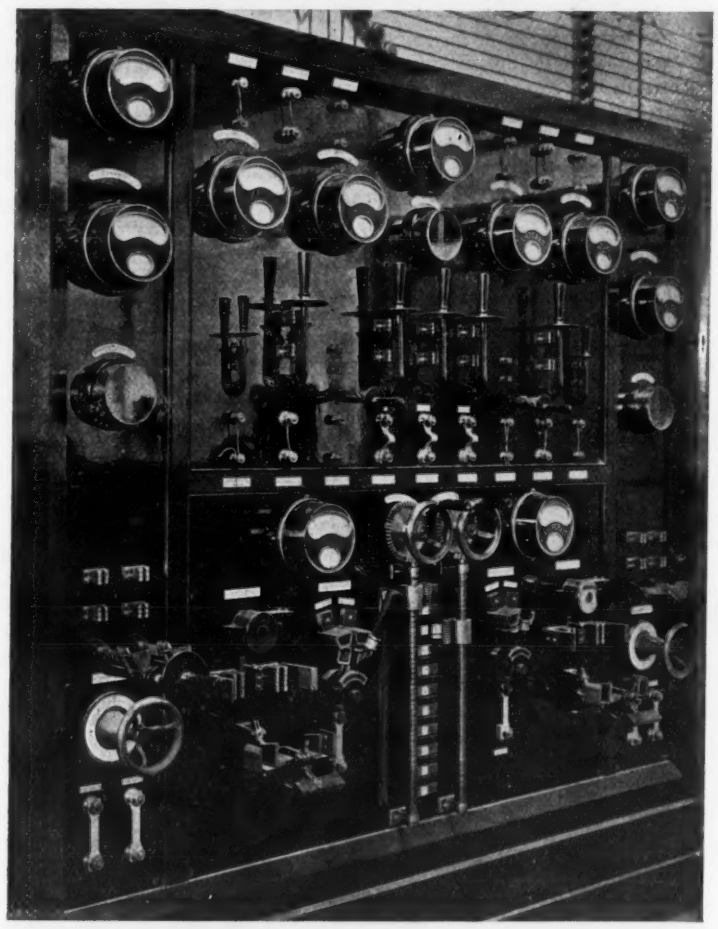


FIG. 3.—SWITCHBOARD.

are split up into groups of not more than the equivalent of eight 16-cp lamps per group. Each circuit is, of course, also fitted with the usual switches and fuses placed in convenient positions.

The laundry machinery, consisting of one hydro-extractor, two washing machines, two mangles, one ironer, one blower and one ventilating fan, is operated by a 6-hp electric motor. The disinfecting chamber attached to the laundry is divided into two parts. A disinfector is placed in the dividing wall so that infected articles pass in at the one room and can be withdrawn from the disinfector in the other room. The disinfector is fitted with a vacuum apparatus. Steam at a pressure of 22 lbs. per square inch is admitted to the chamber and allowed to stand for some time. It is then turned off and the goods dried by the admission of warm air. The cost of this disinfecting plant was $1,000. The cost of the laundry fittings was $2,750. The electric light and telephone fittings cost $2,000. The gas generating plant and cooking apparatus cost $9,000, and the total cost of the hospital when it is entirely complete, will be about $150,000.

A New Use for Calcium Carbide.

Sulphide ores cannot, as a rule, be reduced directly by carbon, but must undergo a preliminary roasting operation to remove the sulphur, the last traces of which are eliminated with extreme difficulty. Accordingly, when Mourlot directed attention some three years ago to the remarkable stability of calcium sulphide at electric furnace temperatures, the observation was sufficient to direct attention to the possibility of reducing sulphide ores directly by calcium carbide. Early in 1900 an account of investigations along this line was published by Geelmuyden, who found that pyrite, tetrahedrite, galena, stibnite and sulphide of magnesium were readily reduced by calcium carbide, the stable monosulphide of calcium remaining in the crucible, the metals of the ore being liberated and, in the cases of compounds of lead, antimony and magnesium, volatilized. Aluminum sulphide alone proved capable of resisting the powerful reducing agent.

M. Louis Michel Bullier, whose claims as original discoverer of crystalline calcium carbide have been recently upheld by the French courts, now describes an interesting extension of the foregoing principle, whereby the metals are recovered directly from mixed sulphide ores and an efficiency of nearly 90 per cent is obtained. If copper sulphide be fused in presence of a suitable flux for which a blast furnace slag melting, according to the patent, at about 1500 degs. C. is found available, and calcium carbide added in theoretical proportions, the reduction occurs readily, the calcium sulphide dissolving in the slag and the copper being recovered as an ingot free from sulphur. If copper pyrites be subjected to the same treatment it is found that the ingot obtained is composed by two sharply separated layers of which the lower is copper and the upper iron saturated with carbon. For ores containing zinc or other metal volatile at the temperature used, a closed retort may be employed and the vapors condensed in the usual manner. The reduction of copper pyrites by this method requires an amount of 80 per cent carbide somewhat exceeding the weight of the ore; for copper sulphide the carbide and ore are used in the ratio 1 : 2.

Introducing the Telegraph in Chili.

It is stated that when the electric telegraph was introduced into Chili strategy was resorted to in order to guard the poles and wires against damage on the part of the natives and to maintain the connection between the strongholds on the frontier. There were at the time between 40 and 50 captive Indians in the Chilian camp. General Pinto, in command of the operations, called them together and, pointing to the telegraph wires, said:

"Do you see those wires?"

"Yes, General."

"I want you to remember not to go near or touch them, for if you do your hands will be held, and you will be unable to get away."

The Indians smiled incredulously. Then the General made them each in succession take hold of the wire at both ends of an electric battery in full operation, after which he exclaimed:

"I command you to let go the wire!"

"I can't. My hands are benumbed!" cried each Indian.

The battery was then stopped. Not long after the General restored them to liberty, giving them strict instructions to keep the secret. This had the desired effect, for, as might be expected, the experience was related in the strictest confidence to every man in the tribe, and the telegraph remained unmolested.

The Tractive Horse Power of Vehicles.

GRADE PER CENTS—TRACTION COEFFICIENTS OF TIRES AND PAVEMENTS—WIND RESISTANCES.

BY W. F. D. CRANE, M. E.

THE frequent questions regarding the capacities of the motors necessary to propel automobiles of various weights through wide ranges of speed on levels and on grades, render useful for quick and handy reference such a table as is here given for the calculations and comparisons of the horse-power required.

The horse-power per ton weight of the vehicle given in the table are derived from the general formula for the horse-power of traction:

$$HP = \frac{W \times S \times K}{33000} \pm \frac{W \times 2000 \times \sin a}{33000}$$

in which W = total weight of vehicle and its load in tons of 2000 lbs.
S = speed in feet per minute.
a = the angle of the grade.
K = the coefficient of traction or the resistances to the motion of the vehicle in pounds per ton.

In traction calculations, grades are most conveniently stated in per cent, or the decimal relation between the measured length of the grade and its vertical height above a horizontal base line drawn from its foot or base. Thus, if a hill be 100 ft. long and the elevation at the end of that distance be 10 ft. the grade will be 10 per cent.

The coefficient of traction K, or the resistance to the motion of a vehicle, is usually stated as so many pounds per ton weight of the vehicle. It is a variable quantity depending upon the character of the tires, the nature of the road surface, the sizes of the wheels, the speed and weight of the vehicle and includes the friction losses in hub journals; and in the motor-driven vehicle, includes also the friction losses in motor and machinery, when no allowances are made therefor. Other things remaining equal, it should vary inversely as the diameters of the wheels, and on hard roads with iron tires at slow speeds, has been found to increase with the speed, but not in proportion to the velocity. It has also been found that the width of tire has no apparent effect upon the tractive force on hard roads. A knowledge of its value under given conditions is one of the first essentials for comparing the merits of different tires for traction purposes, aside from their resilient and wearing qualities, and for predetermining the capacity of a vehicle motor when working under known or assumed conditions of speed and weight of vehicle; and, vice versa, for ascertaining the performance of a self-propelled vehicle equipped with a motor or engine of definite horse-power.

Under city conditions, unless the machinery be unusually inefficient, the character and conditon of the tires will be usually more influential in determinng the power required to propel the vehicle than the ordinary good and bad conditions of asphalt, block and macadam pavements. This is especially true for pneumatic tires, the most important consideration being whether they are soft or "flat," or are well inflated. Many experiments have been made in various countries to determine the draw-bar pull existing between the horse and the load drawn. The figures thus obtained are instructive as affording comparisons of the effects of different road surfaces upon the traction coefficient, and, in the absence of statements to the contrary, it may be assumed that the tires were of iron or steel, and that the values of K obtained, in addition to the rolling resistance between the wheels and the ground, included the friction in the hub journals; also that there were no other resistances to be recorded. In the motor-driven vehicle of to-day, however, allowances must be made for internal losses in the motors and driving mechanism before similar values of K can be obtained for comparison with the figures obtained with the horse-drawn vehicle. Since, also, the present variable character of the rubber tire has a potent influence upon the amount of power necessary to propel a vehicle, it is desirable that the traction coefficient for each kind of tire be known for the various pavements.

From published figures it is learned that the draw-bar pull or tractive force varies from between 8 and 11½ lbs. on railroad tracks to 448 lbs. per ton for loose sand with metal wagon tires at a speed of 3 miles per hour. Other figures obtained with the road conditions existing abroad for iron tires at 3 miles per hour, quoted for comparison, are:

	Pounds.	Average, About.
Loose gravel road, from	125 to 320	150
Ordinary dirt road, from	89 " 224	150
Cobblestones, from	75 " 140	100
Macadamized surface, from..	32 " 112	42
Belgian block, from	26 " 56	38
Asphalt, from	17 " ..	..

More recent figures obtained by the Office of Road Inquiry, probably more nearly corresponding to similar conditons in the United States, are, in pounds per ton:

	Pounds.
Loose sand (experimental)	320
Best of clay roads	98
Cobblestone	54
Best gravel (park road)	51
Poor block pavement	42
Best macadam	38
Poor asphalt	26

In tables I. and II. are published for the first time some values of K obtained from tests of electric automobiles. Two values for K

TABLE I.
TRACTION TESTS OF TRACTION VEHICLES.

K in lbs. per ton		Vehicle		Sizes and kinds of rubber tires	Sizes of Wheels		City pavements in good condition
Gross values	Values for tires	Weight in lbs.	Speed m. p. h.		Front	Rear	
66	49	1790	14.00	3 in. pneumatic	28	28	Macadam
66	52	1775	13.81	3 " "	28	28	"
55	39	2730	12.45	3 " "	32	36	"
68	52	3140	11.67	3 " "	36	36	"
64	47	1870	15.30	2½" "	28	32	Asphalt
64	46	5380	9.00	4 " "	36	36	"
54	40	4400	11.20	2½" solid	36	36	"
48	35	5425	11.15	2½" "	36	42	"
59	43	7240	7.30	3 " "	38	42	"
58	42	7240	10.00	3 " "	38	42	"
48	36	8480	8.20	4 " "	38	44	"
53	38	4150	11.90	2½" "	36	42	Macadam

were sought in the calculations. First, the gross value of all the resistances to traction, including the inefficiency of the motors, the friction losses in driving mechanism and hub journals, the rolling friction of the tires, electric losses in the wiring of the vehicles, etc., and, second, the net value of K or the coefficient of traction of the tire *per se* for comparisons with other tires or with the same time on

TABLE II.

K in lbs. per ton		Vehicle		Sizes and kinds of rubber tires	Sizes of Wheels		City pavements in good condition
Gross values	Values for tires	Weight in lbs.	Speed m. p. h.		Front	Rear	
71	51	4300	10.50	5 in. pueumatic	36	36	Asphalt
52	37.5	5390	12.60	3 in. solid in front			
55	39.5	5390	11.90	4 in. pneumatic in rear	36	36	"
59	42.5	4150	11.15				
48.5	36	5780	9.75	3 inch sectional	36	36	"
38.5	28.5	7900	9.05				

other pavements. It is assumed that the pneumatic tires in the tests were in excellent condition and fully inflated under pressures of about 80 lbs. for the 2½-inch tires, 100 lbs. for the 3-inch and about 120 lbs. for the 4 and 5-inch tires.

Compared with the usual dynamometric methods the electric vehicle, through the use of the voltmeter and ammeter, affords one of the simplest and most sensitive means for experimenting with traction resistances, but a knowledge of the efficiencies of the motors and gearing at the time is essential for a correct interpretation of the results. It is believed that the figures given in the tables are sufficiently exact to be representative for rubber-tired electric and other vehicles with the tires and city pavements in good condition.

In the vehicles tested the efficiencies of the motors, as determined from their efficiency curves, ranged from 79 to 85 per cent with a general average of about 81 per cent. The friction losses in the gearing was assumed to amount to 8 or 10 per cent, amounts obtained from certain tests of the arrangements of two gears and two pinions common to all the vehicles. An allowance of 2 per cent was made in certain cases to cover the friction losses in hub journals, with plain

sleeve bearings, losses in the electric wiring, etc. The efficiency of the combination of a motor at 82 per cent, gearing at 90 per cent, and the other conditions at 98 per cent would, therefore, be about 72 per cent. If the gross K, as computed from the results of a test, amounted to 55, the value of net K, or the tire coefficient, would be $55 \times .72 = 39.6$ lbs. per ton. The values of the tire coefficients, as given in the tables, were computed by this method, no allowances having been made for the wind resistance as no records of the force and direction of the wind, if any, were taken at the times of the tests.

The friction losses in the power-transmission gearing in gasoline and steam vehicles may be variously estimated at from 10 to 30 per cent or more of the power delivered by the motor or engine depending upon the nature and condition of the mechanism. The losses through countershafting, bevel gearing, chains, speed-reducing gears, universal joints, etc., will vary greatly with their design, lubrication, condition, etc., and should properly be determined by actual measurements. Losses in hub journals will also vary from practically nothing with suitable ball or roller antifriction bearings to 2 per cent and more with plain sleeve bearings, according to their design, size and lubrication of the surfaces.

In table I. the average of the results obtained for the six vehicles equipped with pneumatic tires on both macadam and asphalt pavements (the respective figures for which show but slight differences) is a gross value for K (for electric vehicles) of 65, and an average tire coefficient of 47 lbs. per ton. Similarly, for the six vehicles with solid tires, the corresponding averages are 53 and 40 lbs. per ton, respectively. In table II. are given some results of tests of vehicles with miscellaneous rubber tires.

It is instructive to compare the tabulated figures for the rubber tire coefficients with those quoted for the iron-tired slow-speed wagons, in view of the fact that iron or steel tires have been contemplated by automobile manufacturers of heavy slow-speed trucks as substitutes for the costly and short-lived rubber tires. It is a noteworthy observation that almost without exception the solid rubber tires which show the lowest traction coefficients (below 40) in the table have suffered the greatest damage to themselves in service and possessed the shortest lives. The results of the tests indicate that from 20 to 25 per cent more power is expended by pneumatic-tired vehicles than those equipped with solid rubber tires on good macadam and asphalt pavements, but it does not follow, from the viewpoint of ultimate economy, that the solid tire will always possess such an apparent advantage over the pneumatic tire.

If we assume that the general efficiency of the gearing in a gasoline or steam vehicle is 75 per cent, and that the tire coefficient is 45 lbs. per ton, the gross value of K will be 60 lbs. per ton with a rating of the motor in brake horse-power. This is probably a safe figure for city pavements of asphalt, macadam and Belgian block. On country roads this value of K (60 lbs.) can be readily increased two and more times, as is shown by the comparisons offered by the figures quoted for clay, sand and dirt roads.

As it is the desire in the present article to generalize and to produce a table of the horse-power of traction for convenient approximations and comparisons, the value of K in table III. has been taken at 60 lbs. per ton as a figure at the present time most likely to approximate its average value for the largest number of vehicles operating under the various conditions of tires, speeds and city pavements.

By substituting in the general formula quoted for the horse-power of traction the speed in miles per hour, instead of in feet per minute, and the grade in per cent for *sin a*, the formula may be simplified to the following expression:

$$H\text{-}P = \frac{W S K}{375} \pm \frac{W S G \times 20}{375}$$

in which W = total weight of the vehicle in tons of 2000 lbs.
S = speed in miles per hour.
K = total resistances to motion of vehicle in pounds per ton.
G = per cent of the grade in numerals.

In the table the tractive horse-powers per ton have been calculated for both levels and grades with K at 60 lbs. per ton. The results are tabulated in the two parts into which the table naturally divides itself: The horse-power to propel one ton on the level at the speeds given being found in the column headed "H.-P. per ton on level $K = 60$"; and the corresponding *additional* and invariable horse-power per ton on grades, irrespective of whatever power may have been required to propel the vehicle over the surface of the ground, being found (in the lighter figures) in their respective columns headed by the per cents of the grades. The lines of darker figures are the *total* horse-power per ton required to propel the vehicle over the grades with $K = 60$, and were obtained in each case by adding the horse-power on the level to the additional horse-power on the grades for the corresponding speeds.

To illustrate: What horse-power will be required to propel a vehicle weighing 2 tons on a 6 per cent grade at 5 m. p. h.? The tabulated horse-power for one ton on the level, in the column headed $K = 60$, at 5 m. p. h. is .80, which, multiplied by 2 equals 1.6 horse-power. The *additional* horse-power per ton on a grade of 6 per cent at 5 m. p. h. is 1.60, which multiplied by 2 equals 3.2 horse-power., This added to 1.6 horse-power, the horse-power on the level, given a total of 4.8 horse-power, or the same result will be obtained directly by multiplying by 2 the tabulated *total* horse-power for one ton, viz., 2.40, or a total of 4.8 horse-power. If this be an electric vehicle the power demanded of the battery will be $4.8 \times 746 = 3580$ watts, which at 81 volts will mean a discharge rate of over 44 amperes. If the grade is ascended at 8 m. p. h. what current will be required? Answer: $3.41 \times 2 = 6.82$ hp $\times 746 = 5087$ watts at 80 volts $= 64$ amperes.

TABLE III.—THE TRACTIVE HORSE-POWER OF VEHICLES.

Computed by W. F. D. CRANE, M. E.

General formula: $H\text{-}P = \frac{W n}{375} (K \pm 20\ G)$ G = per cent. of grade.

W = weight in tons of 2000 lbs. K = resistance to traction in pounds per ton. n = speed in miles per hour.

Miles per hour	Horse Power per ton on level		HORSE-POWER PER TON ON GRADES. The LIGHT figures are the ADDITIONAL and invariable H-P per ton on grades. The HEAVY figures are the TOTAL H-P per ton on grades with K equals 60.										
	$K=10$	$K=60$	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%
1	.026		.053	.106	.16	.213	.266	.32	.373	.426	.48	.533	.586	.64
		.16	.213	.266	.32	.373	.426	.480	.533	.586	.64	.693	.746	.80
2	.053		.106	.213	.32	.426	.533	.64	.746	.853	.96	1.06	1.173	1.28
		.32	.426	.533	.64	.746	.853	.96	1.06	1.17	1.28	1.38	1.49	1.60
3	.080		.160	.32	.48	.640	.800	.96	1.12	1.28	1.44	1.60	1.76	1.92
		.48	.640	.80	.96	1.12	1.28	1.44	1.60	1.76	1.92	2.08	2.24	2.40
4	.106		.213	.426	.64	.853	1.06	1.28	1.49	1.70	1.92	2.13	2.34	2.56
		.64	.853	1.06	1.28	1.49	1.70	1.92	2.13	2.34	2.56	2.77	2.98	3.20
5	.133		.266	.533	.80	1.06	1.33	1.60	1.86	2.13	2.40	2.66	2.93	3.20
		.80	1.06	1.33	1.60	1.86	2.13	2.40	2.66	2.93	3.20	3.46	3.73	4.00
6	.160		.32	.64	.96	1.28	1.60	1.92	2.24	2.56	2.88	3.20	3.52	3.81
		.96	1.28	1.60	1.92	2.24	2.56	2.88	3.20	3.52	3.84	4.16	4.48	4.80
7	.186		.373	.746	1.12	1.49	1.86	2.24	2.61	2.98	3.36	3.73	4.10	4.48
		1.12	1.49	1.86	2.24	2.61	2.98	3.36	3.73	4.10	4.48	4.85	5.22	5.60
8	.213		.426	.853	1.28	1.70	2.13	2.56	2.98	3.41	3.84	4.26	4.69	5.12
		1.28	1.70	2.13	2.56	2.98	3.41	3.84	4.26	4.69	5.12	5.54	5.97	6.40
9	.240		.48	.96	1.44	1.92	2.40	2.88	3.36	3.84	4.32	4.80	5.28	5.76
		1.44	1.92	2.40	2.88	3.36	3.84	4.32	4.80	5.28	5.76	6.24	6.72	7.20
10	.266		.533	1.06	1.60	2.13	2.66	3.20	3.73	4.26	4.80	5.33	5.86	6.40
		1.60	2.13	2.66	3.20	3.73	4.26	4.80	5.33	5.86	6.40	6.93	7.46	8.00
11	.293		.586	1.17	1.76	2.34	2.93	3.52	4.10	4.69	5.28	5.86	6.45	7.04
		1.76	2.34	2.93	3.52	4.10	4.69	5.28	5.86	6.45	7.04	7.62	8.21	8.80
12	.320		.64	1.28	1.92	2.56	3.20	3.84	4.48	5.12	5.76	6.40	7.04	7.68
		1.92	2.56	3.20	3.84	4.48	5.12	5.76	6.40	7.04	7.68	8.32	8.96	9.60
13	.346		.693	1.38	2.08	2.77	3.46	4.16	4.85	5.54	6.24	6.93	7.62	8.32
		2.08	2.77	3.46	4.16	4.85	5.54	6.24	6.93	7.62	8.32	9.01	9.70	10.40
14	.373		.746	1.49	2.24	2.98	3.73	4.48	5.22	5.97	6.72	7.46	8.21	8.96
		2.24	2.98	3.73	4.48	5.22	5.97	6.72	7.46	8.21	8.96	9.70	10.45	11.20
15	.400		.800	1.60	2.40	3.20	4.00	4.80	5.60	6.40	7.20			
		2.40	3.20	4.00	4.80	5.60	6.40	7.20	8.00	8.80	9.60			
16	.426		.853	1.70	2.56	3.41	4.26	5.12	5.97	6.82	7.68			
		2.56	3.41	4.26	5.12	5.97	6.82	7.68	8.53	9.38	10.24			
17	.453		.906	1.81	2.72	3.62	4.53	5.44	6.34	7.25	8.16			
		2.72	3.62	4.53	5.44	6.34	7.25	8.16	9.06	9.97	10.88			
18	.480		.960	1.92	2.88	3.84	4.80	5.76	6.72	7.68	8.64			
		2.88	3.84	4.80	5.76	6.72	7.68	8.64	9.60	10.56	11.52			
19	.506		1.01	2.02	3.04	4.05	5.06	6.08	7.09	8.10	9.12			
		3.04	4.05	5.06	6.08	7.09	8.10	9.12	10.13	11.14	12.16			
20	.533		1.06	2.13	3.20	4.26	5.33	6.40	7.40	8.53	9.60			
		3.20	4.26	5.33	6.40	7.46	8.53	9.60	10.66	11.73	12.80			
25	.666		1.33	2.66	4.00	5.33	6.66	8.00	9.33	10.66	12.00			
		4.00	5.33	6.66	8.00	9.33	10.66	12.00	13.33	14.66	16.00			
30	.800		1.60	3.20	4.80	6.40	8.00	9.60	11.20	12.80	14.40			
		4.80	6.40	8.00	9.60	11.20	12.80	14.40	16.00	17.60	19.20			
35	.933		1.86	3.73	5.60	7.46	9.33	11.20	13.06	14.93	16.80			
		5.60	7.46	9.33	11.20	13.06	14.93	16.80	18.66	20.53	22.40			
40	1.066		2.13	4.26	6.40	8.53	10.66	12.80	14.93	17.06	19.20			
		6.40	8.53	10.66	12.80	14.93	17.06	19.20	21.33	23.46	25.60			
45	1.20		2.40	4.80	7.20	9.60	12.00	14.40	16.80	19.20	21.60			
		7.20	9.60	12.00	14.40	16.80	19.20	21.60	24.00	26.40	28.80			
50	1.33		2.66	5.33	8.00	10.66	13.33	16.00	18.66	21.33	24.00			
		8.00	10.66	13.33	16.00	18.66	21.33	24.00	26.66	29.33	32.00			
55	1.46		2.93	5.86	8.80	11.73	14.66	17.60	20.53	23.46	26.40			
		8.80	11.73	14.66	17.60	20.53	23.46	26.40	29.33	32.26	35.20			
60	1.60		3.20	6.40	9.60	12.80	16.00	19.20	22.40	25.60	28.80			
		9.60	12.80	16.00	19.20	22.40	25.60	28.80	32.00	35.20	38.40			

Wind Resistances per sq. foot.
$p = .005\ V^2$
V = miles per hour.

Miles per hour	p = pressure in lbs	Equivalent H-P
5	.125	.0016
10	50	.0133
12½	.687	.0229
15	1.125	.0452
17½	1.53	.0716
20	2.00	.1066
25	3.125	.208
30	4.5	.360
35	6.125	.572
40	8.00	.853
45	10.125	1.215
50	12.50	1.67
55	15.125	2.22
60	18.00	2.88

What is the steepest grade that a vehicle weighing one ton and equipped with a motor rated at 6 horse-power can ascend at a speed of 10 m. p. h.? By inspecting the table for the total horse-power on grades at 10 m. p. h. we find that 5.86 horse-power is the nearest approximation to 6 horse-power, and that this corresponds to a grade of 8 per cent.

If the limit of a vehicle's speed on the level is 18 m. p. h., at what speed will it ascend a 6 per cent grade, other things being equal? Answer, 6 m. p. h.

If the value of K be known, or assumed, the tabulated figures for the horse-power on the level with $K = 10$ can be increased or decreased proportionately and added to the invariable figures for the additional horse-power on grades to obtain the total horse-power per ton. Since K only enters one term of the formula, manifestly the figures for the total horse-power on grades cannot be altered proportionately, in correspondence with the value of K, on account of the preponderating amount of power required on grades compared to that on levels, as strikingly illustrated by the related figures.

The gross value of K for any vehicle may be found by transposing the formula so that

$$K = \frac{H\text{-}P \times 375}{W \times S} - 20\ G$$

and substituting known values for the horse-power, weight, speed and grade. For example, a solid rubber tired electric vehicle weighing, with passengers, 4400 lbs. (2.2 tons) on a level attained an even speed of 11.2 m. p. h. with 31.5 amperes at 83.5 volts, or 3.5 electrical horse-power. Substituting these quantities in the formula, we have

$$K = \frac{3.5 \times 375}{2.2 \times 11.2} = 53.5 \text{ lbs. per ton.}$$

The efficiency of the motor at the speed and load was 83 per cent and of the gears, etc., 90 per cent, or a combined efficiency of 74.7 per cent, the actual percentage of the power required to overcome the rolling friction of the tires. Hence, $53.5 \times 74.7 = 40$, the net value of K, or the traction coefficient for the tire and pavement under the conditions prevailng at the ime of the test.

In determinations of the tractive horse-power of vehicles at moderate speeds, the resistance of the air is frequently disregarded as of little consequence, but at the higher rates of speed the wind resistance cannot be neglected without seriously underestimating the power required to speed the vehicle. For a vehicle weighing one ton and presenting 10 square feet of surface at a speed of 35 miles per hour, the power required to overcome the resistance of the air due alone to the motion of the vehicle will exceed the power required to propel the vehicle on the level with $K = 60$.

The pressure of the air at right angles to a surface varies as the squares of the speeds and may be found from the formula

$$p = .005\ V^2,$$

in which p is the pressure in pounds per square foot and V the velocity in miles per hour, or from

$$p = .0023\ v^2 = \frac{v^2}{400}$$

in which v is the speed in feet per second.

The wind pressures and equivalent horse-power per square foot of surface at various speeds are given in the table in connection with the table of the horse-power of traction.

Examples.—A buggy-topped runabout presenting 20 square feet of surface to the wind travels in a calm day at the rate of 15 m. p. h. What horse-power is the motor exerting to overcome the wind resistance? The tabulated horse-power at 15 m. p. h. in the table of wind-resistances is .0452 horse-power per square foot. This multiplied by 20 equals .9 horse-power.

What must be the capacity of a motor to drive a racing automobile weighing two tons and presenting 10 square feet of surface at 60 m. p. h. on the level? Horse-power of traction on level equals $9.60 \times 2 = 19.20$. Horse-power due to wind resistance $2.88 \times 10 = 28.80$. Total, 48 horse-power.

Russian Submarine Boat.

Information comes from St. Petersburg that an electrically propelled submarine boat, designed by Lieutenant Kolbasjeffs of the Russian Navy, is being built at Kronstadt by order of the Government.

The United States Signal Corps in Foreign Service.

BY F. E. GRAIN.

IN 1899, when I arrived in Iloilo, Isle de Panay, the only lines of wire in service were those employed in connecting the leading cities and towns within a very small radius. No signal corps man could go out far enough from the protected centers to put up lines. All messages had to be transmitted between points by carriers accompanied by guards, and oftentimes these details were fired upon by the insurgents or the ladrones. It was unsafe to put up wires of any sort, for they were at once cut, or the working parties shot. After about one year, when the Americans commenced to occupy the interior towns, it was found necessary to establish lines from point to point, and then the real troubles of the signal corps began. While the operations were confined to Iloilo province, there was not much need for signal corps men, nor was there much danger. As soon as military necessities demanded that the signal corps go into the field the demand for operators and linemen started in and has been maintained ever since. No one can have any idea of the demand for sergeants, corporals and linemen who are privates, as well as native linemen, unless he is on the ground. I know that very many stations were often closed for lack of operators. In many of the larger places where there are many central wires coming in, and where telegraphing is kept up practically all of the time, one operator does the work although the officers know that there ought to be two and even three. The reason is that operators cannot be obtained.

The chiefs of the signal corps department are, of course, doing all they possibly can to get trained men into the service and relieve the

SIGNAL CORPS IN THE PHILIPPINES.

hardworked men who are at the posts. There are many new men sent to the Philippines by every transport, but the lines are extended so rapidly and so many new offices are being so constantly opened, that it is impossible to keep up with the work. The recruiting officers in America are doing all they can to get good men and plenty of them, and very fair wages are paid, even to the new men, who, as a rule, are enlisted for three years as privates. They are in line for promotion, and in a very short while I observe them recorded as first-class privates, and from this grade it is not long before they are made corporals. When finally appointed first-class sergeants, their future is bright, for the pay is not only good, but the position is suitable. The first-class electrical sergeant in the islands can save about $50 per month from his salary, as he is provided with rations, clothing, quarters, etc., and his chances for spending money are not very great. I saved more money while I was in the service there than I ever saved before in the same time.

The offices of the United States Signal Corps in the islands are usually established in the convents of the cities and towns, and are fitted up with the apparatus usually found in a telegraph station. There are large stone convents in all of the cities and towns, and even in the barrios. The Spanish erected these convents and arranged that portions be separated for church worship. American troops occupying the cities and towns usually make their headquarters at the convents as no other buildings are available. Therefore one will usually find the American flag flying over the convent of a city or town while the soldiers, officers' quarters and Signal Corps station will be established therein. The great, thick walls of the

building assure safety against attack from the rebels. In these convent stations one will find not only the telegraph instruments to which wires may center from a dozen different stations, but telephone instruments, and full equipments of signals. I have been in many a station where the busy office is run by one man. Not because the chief signal officer of the district is stinting with his men, but just simply because there are no extra men to use. I know that I have stopped many a night in these convent signal corps stations and relieved men who have been without sleep for hours.

The signal corps man in the Philippines must be a good lineman. For example, we used to get orders to the effect that the wires were down a dozen miles out. The only thing to do is to get a detail of soldiers from the post as a guard, select two or three of the native police to round up about 10 natives, and then the whole force moves out to the point where the rebels had played with the lines by cutting the poles into little bits and snarling the wires into tangled bunches, as well as smashing the crossarms and glass knobs.

I have seen things pretty badly smashed by the insurgents, and often the ingenuity of the telegraph operator is taxed. Sometimes the poles are chopped to pieces, and there are no means of getting poles within a dozen miles. The wires must be put up and the line opened at once because of military necessity, for it is when troubles occur with the wires that the rebels take advantage of the chance to attack isolated stations, knowing well that there will be no means for wiring for aid. I have seen thin bamboo poles wound together with hempen stuff so as to make a substantial pole for holding wires. Sometimes the crossarms have to be of bamboo, and then skill is needed to get a good base. The rebels are up to all sorts of tricks. I have known them loosen the wires in such way that they will drop across the roads and then when troops rush through at night on horseback the soldiers are liable to get swept from their saddles. I have seen many persons with cut faces from this cause. When a signal corps man is alone in a station he has considerable mechanical work to do. There are parts of instruments wearing and breaking, and unless he is a master of his business, he will have trouble. There are no electrical supply stores outside of Manila and Iloilo, and what few hardware stores there are in the islands, do not carry any proper assortments of screws, bolts, nuts and other small mechanical furnishings which would be of great service to the operators. Screws, bolts and the like when wanted, must be laboriously cut from metals, consuming much time and resulting in a poor piece of work.

During the occupation of the islands, large assortments of colored flags, rockets and lights have been put into all of the stations. In rare cases, regular company signal men are stationed, and these men handle the colored flags and lights. But in most instances the display of signals from point to point by colored flags or rockets, is done by the operator; in fact, the poor operator in the tropics is the handy man. He must understand the local code of signals as delivered at night with colored lights, and in the daytime with colored flags. At one station where I was located for several months, we used the church tower as a signal station. White meant country clear, blue, enemy near; red, a probable attack. It was so arranged that by combining colors, the direction of rebel troops could be signaled and also the form of marching, numbers, etc. I know that at times the signal man would hardly finish a message when he would have to climb the ladder to the tower to signal and then rush back to his den, there to hear his station call on the wires and the bells of the telephone ringing his station. The noble fellows in the foreign service deserve much credit. I could give the names of several heroes whom I met in the Philippines, whose names ought to go into history. For instance, one day Lieutenant Wildeman, on Panay Island, rode alone on horseback from Miagoa to Iloilo, through the rebel country to get to Iloilo to appear at an important meeting of officers on military matters. I met with Operator Charles Hart at Oton, when he was so ill with fever that he could hardly stand, and he attended to all of his duties like a hero, sending and receiving messages day and night when he ought to have been in the hospital. His superior officers made all possible efforts to get him relieved by another operator, but emergency of war prevented for several days. Finally an operator came out from Iloilo and relieved him. Operator Syder, of Tigbauan, is another man I remember as being brave and faithful, for he used to go out into the jungle with a very small guard to replace broken wires. Robinson, of Leon, went out with a column once, as signal man, and was under fire, receiving, I believe, special mention.

Arc Lighting at the Beginning of the Twentieth Century.*

The paper of Mr. W. H. Hillman, with this title, was largely devoted to bringing out the merits of the constant-current transformer system of arc lighting. During the past two years it is stated that 50,000 lights capacity of enclosed arcs has been installed for street lighting, of which 30,000 lights capacity is represented by alternating arcs. Enclosed arcs have been adopted by 350 cities, of which 300 have introduced alternating arcs. About 270 cities are operating 6.6 ampere lamps, consuming only 430 watts (average), as compared with about 30 of the 7.5 amperes, consuming 485 watts (average). Attention is particularly called to this latter point, because it shows that as far as volume of light is concerned, the alternating system has fully met the demand; in fact, while the 7.5-ampere, 485-watt lamp has been available since the system was first introduced, 90 per cent of the cities and towns have adopted the lower energy lamps, consuming only 430 watts. If the limiting feature of the system had been in respect to the volume of light from an alternating lamp, surely the 7.5-ampere system would have been adopted exclusively.

Many schemes have been considered in connection with street lighting from the alternating system. Quite frequently the argument is presented that multiple alternating lamps can be used with practically the same degree of economy and convenience, which has favored the series-alternating system. Where the wires from the old arc systems were strung out from the station in pairs, instead of a loop, there would be a greater tendency to consider an installation of the multiple lamp. The question would naturally arise as to whether they would be installed on those constant potential transformers, which were used for commercial and residence lighting. If so, the lamps would have to be controlled individually, necessitating switching them off and on by an attendant, or collectively, by means of some magnetic switch. The first method would be expensive, and lamps would not be lighted simultaneously. The second method would require special additional wiring. At the present writing, street lighting by multiple

COST OF MAINTAINING ENCLOSED SERIES ALTERNATING-CURRENT STREET ARC LAMPS, HAMPTON, VA., 1900.

	June.	July.	Aug.	Sept.	Oct.	Nov.
No. of hours burning	240	248	294	307	372	411
Average life of carbons	41.50	61.55	80.07	60.00	70.00	75.00
No. of lamps	69	69	69	69	81	81
No. of solid carbons used	200	145	166	176	215	222
Cost of solid carbons	$4.45	$3.13	$3.70	$3.92	$4.78	$4.94
No. of cored carbons used	199	146	166	177	215	222
Cost of cored carbons	$4.73	$3.47	$3.94	$4.41	$5.11	$5.27
Inner globes used	5	5	7	10	5	8
Cost of inner globes	$0.95	$0.95	$1.05	$1.50	$0.95	$1.20
Outer globes used	6	2	3	1	6	3
Cost of outer globes	$2.70	$0.90	$1.35	$0.45	$2.70	$1.35
Labor trimming, clean., etc.	11.70	11.70	11.70	11.70	13.95	13.95
Total cost of maintenance	25.53	21.15	21.74	21.98	27.49	26.71
Cost per light	.37	.306	.315	.317	.338	.329

alternating lamps has simply been considered in isolated cases. The idea does not seem to have special merit.

Another method which has been suggested might be illustrated in connection with a 500-light system. A large constant potential transformer installed at the station is arranged with loops brought out on the secondary side to accommodate ten 50-light circuits; each circuit having a reactive coil installed as a regulator for series-alternating lamps. One objection to this arrangement would be that, should any accident happen to this transformer, the entire arc-lighting system is put out of service. If an attempt is made to avoid this point by using two or three smaller size transformers, the system becomes complicated and the attempt to secure high efficiency, together with low cost, is defeated.

During the years of 1895 and 1896, records show that only a few alternating open-arc lamps were in use. Not more than 1000 to 1500 alternating lamps were introduced by central stations during the year 1896. In 1897, the first satisfactory enclosed-alternating lamp was made commercially successful, and in the years 1897 and 1898, between 20,000 and 30,000 lamps were placed in actual service. During 1899 practically 30,000 of these lamps were required to meet the demands of the central stations, while during the year 1900, between 50,000 and 60,000 alternating lamps were installed. As a result, about 125,000 alternating lamps are to-day in actual service. Most

* Abstract of paper read at the Niagara Falls Convention of the National Electric Light Association, May 23, 1901.

of these have been installed during the short period of three years. They have made it possible for stations equipped with alternating generators to establish their commercial arc lighting on a profitable basis, meet competition from Welsbach burners, and contract with their respective cities for the street service, with a commercial system of alternating street arc lighting.

Estimated conservatively, the additional income to the central station business, since the introduction of alternating-arc lamps, has been from $5,000,000 to $8,000,000.

In the past, the attention has been called almost entirely to the *estimated annual* cost of operating enclosed arcs. The table on page 929 shows the actual figures taken from the books of an electric lighting company, and is representative of central station practice. It is of interest to note how closely the figures representing actual practice approximate the estimated figures which have been commonly recognized heretofore.

Exhaustive experiments to date have not as yet been sufficiently successful to warrant the standardization of solid carbons for alternating lamps. On the contrary, the best practice favors one cored carbon for such lamps. It is a fair question to ask, "Why was the alternating lamp designed to take 9½-inch carbons, as against the standard 12-inch length?" Good reasons may be given, namely: in a direct-current lamp the positive carbon burns twice as fast as the lower. A 12-inch carbon is therefore necessary. In an alternating lamp the upper carbon is consumed at the same rate as the lower.

In reply to a question as to what methods may be used to overcome the induction on telephone lines paralleling series alternating arc light lines, Mr. Wagner said that in general it is pretty hard to get rid of the trouble if telephone lines form part of grounded circuits. A case was described wherein it was found that the trouble on a telephone line did not arise from electromagnetic, but from electrostatic induction. Mr. Walton spoke of a serious difficulty with telephone lines at Akron, Ohio, which was entirely obviated by proper transposition of the telephone wires. A special single pole telephone receiver was wound with two coils having the same number of turns. The telephone lines were transposed in the daytime and at night after the arc lights were on the transposition was opened by means of this receiver to see which end of the line was the strongest; that is, whether the noise from one end of the transposition or the other was the stronger, the idea being to get the transposition in the center of the noise curve. In the course of a month or so, by this means the lines were so regulated as to give rise to no further trouble. Mr. Almert said that if underground lighting cables do not have their lead coverings connected together a condenser effect occurs which will cause trouble on telephone circuits. He referred to the trouble when the West Park, Chicago, lighting plant started up, neighboring telephone circuits being rendered inoperative in hours when the electric light system was in operation. The trouble was entirely eliminated by connecting the lead shields together where they went up into the pole and grounding them every thousand feet. When these connections were left off a considerable disturbance in telephone service at once followed, Mr. Binley said that when the telephone wires are on the same poles with alternating-current wires, the telephone people always prefer to have their circuits come as much above the lighting circuit as is possible, always 18 inches or more. In this case the induced currents between the lighting circuit and the earth do not affect the telephone circuits as much as would otherwise be the case. Mr. Phipps called attention to the fact that the troubles in the Chicago park above referred to were caused by direct currents, and it appears that in some respects the same difficulties may arise from underground direct currents as from alternating currents.

In reply to a question as to whether certain 650-cp alternating-current enclosed arc lamps which were replaced with 2000-cp direct-current open arcs did not, in fact, require from 10 to 15 per cent more current, Mr. Bechtel said that 2000-cp direct-current arc lamps were replaced with 7½-ampere alternating-enclosed arc lamps. At first there was some little trouble on account of poor operation due to mechanical causes, but at the present time the people like the alternating lamp better than the open arc, as it gives better street and general illumination. Mr. Hillman said that of 300 cities which have adopted alternating-current enclosed arc lamps, 270, or practically 90 per cent, use the 6-ampere, 430-watt lamps. At present about 400 constant-current transformers of the air-cooled type are in use; 25, 35 and 50-light sizes are air-cooled, those of larger capacity being oil-cooled.

American Machinery in the German Market.

In the course of a long and interesting communication to the United States Department, Consul-General Frank H. Mason, of Berlin, Germany, writes as follows: "It must be admitted that, except in a few lines, American exporters have been slow in learning the best methods of utilizing the opportunities which are offered in the German market. The makers of machine tools and shoemaking machinery, typewriters, and a few other specialties learned the lesson early and well, and have profited by their knowledge. But, as a class, the American manufacturer—incomparable as such—is still in the primary grade as a merchant in foreign fields. That this should be so is perhaps a natural result of his education and environment. His success at home has been so complete and satisfying, his confidence in American methods so ingrained and assured, that he finds it hard to realize that customers cannot be won in France, Germany and Russia with catalogues and price lists in English; with measurements, weights and values stated in inches, pounds and dollars; and offering to sell his incomparably superior products for "cash at 10 days sight f. o. b. New York, sight draft with bill of lading attached."

The folly of all this has been explained and written threadbare in consular correspondence and published reports. It has been emphasized in the letters of German agents and importers, but still the confident exporter goes on in his efforts to "teach foreign purchasers American methods of business." If he ventures upon a foreign language it is almost invariably Spanish, and Germany has been strewn with Americo-Spanish catalogues and price lists which are twice as bulky and no more comprehensible to Germans than if printed in English alone. By way of making it pleasant and easy for the foreign customer, he often incloses a United States stamped envelope, printed with his own address, to contain the returning order. If he sends a traveling salesman or agent to study the market and make personal propaganda, the chances are that the emissary will be a bright, energetic, capable young American, who knows all about the goods and how to sell them in the United States or England, but is ignorant of every language but English and helpless beyond the realm of his mother tongue. Even with these disadvantages, the imperfectly equipped salesman often renders a valuable service by studying the actual needs and conditions of the foreign market, finding how it can be best reached, and, as one of them sententiously remarked, "geting the facts to convince our firm at home that Germany is not in the United States."

In respect to size, beauty of print and illustration, the trade catalogues issued by American manufacturers are the most elaborate and beautiful, as well as the most expensive, in the world, but for practical purposes they are often defective in several respects, the most essential of which are too many claims to superiority and too little definite and exact information concerning the weight, dimensions and effective capacity of machinery; absence of metric weights and measurements and prices in francs, marks or other foreign equivalents; and translations, when given at all, made by persons who do not understand the goods, and which are often so incorrect and imperfect as to furnish no adequate technical description of the merchandise. As a result of these defects, intending purchasers are frequently obliged to open a correspondence with the exporting manufacturer in order to obtain clear and definite information. This entails a serious waste of time, and often leads to the loss of orders, which are given to manufacturers of other nationalities, who make careful and complete catalogues specially for the German market, or, what is still better, send a capable traveling salesman to exhibit samples or photographs of the goods and make direct contracts in the office of the purchaser.

Writing in a similar strain from Gera, Saxony, Mr. Charles Neuer, United States Consular agent, says: "American manufacturers are often anxious to make large sales at the start, without considering that new articles can be introduced to consumers only by the expenditure of much patience and perseverance. Great fault is found with our terms of credit. While the business in this country is mainly done on terms varying from three to six months' time, our merchants insist in many cases on cash on delivery, and even before delivery, so that receivers are unable to examine goods before payment, and cannot know whether the shipments are in accordance with orders or not. Of course, the demand for cash on receipt is well justified if the purchaser's financial standing is of a questionable nature; but I know of first-class German houses that have been sub-

jected to the same rigid terms, causing a discontinuation of purchases and material losses to our trade.

"Another point one of my informants laid stress on was the packing of our goods; the greatest precaution should be used in this regard. Care should be taken to prevent breakage, and no old or damaged cases should be used. As the customs duties are levied here on the gross weight, less a certain percentage for tare, the advantage of lightness in packing is essential. Manufacturers who ship goods to this country should thoroughly acquaint themselves with the German tariff, and pack their goods in such a manner as to save the purchaser trouble and useless expense. For instance, a much higher duty is charged on nickel-plated iron than on cast-iron stoves. American shippers of stoves will therefore act wisely if they separate the nickel-plated parts and pack them in one case and the heavy iron parts in another, so as not to have the receivers pay the higher duty on the entire weight. The same is true of many other articles."

Underground Wires in Providence, R. I.

The following report has been made by Starkweather & Shepley, the insurance firm of Providence, R. I., on the underground system in that city:

Some two years ago a city ordinance was passed requiring all aerial electric wires in the close fire district to be placed underground, this to be done before February of this year. This has been very generally complied with, and at the present date, fully 95 per cent of all line wires have been placed in conduits in this district, with the exception of the wires of the Union Railroad Company. The work has also been extended very largely in the outside districts, both the Telephone Company and the Lighting Company having run conduits in several cases to the outlying territory. The city of Providence also appointed several men, whose duty it was to go over this district and remove from the buildings and streets all unused wire. This has been completed, and many miles of abandoned wire have been removed.

The Providence Telephone Company commenced laying its underground system on May 9, 1893, and since that time it has built 10¼ miles of conduit. It is its intention to extend the underground work at a rate of five miles per year, until the whole city is supplied with the underground service. It has laid two kinds of conduits, the cement lined wrought iron pipe and the multiple vitrified clay conduit. It uses a lead-covered paper insulated cable. Its method of distribution is to run from the manholes with lead-covered cable to the building or pole, thence making aerial distribution to group of customers. It uses heavy current protectors where the wires enter buildings in every case.

The Narragansett Electric Lighting Company began its conduit work in 1899, and since that time has laid something over 40 miles of multiple conduit containing about 225 miles of cable. It has used throughout the vitrified clay conduit laid in cement. The cables used are lead-covered with rubber insulation. In most cases connections are made direct from manholes to the building served, the wiring not coming out of the ground at all. The whole system is protected with fuses both in the manholes and where the wiring enters the buildings.

The Rhode Island Electric Protective Company has nearly finished placing all its wires in the conduits of the Providence Telephone Company, using the same materials and style of construction.

The Western Union Telegraph Company and the Postal Telegraph Cable Company have not as yet placed their wires underground to any very great extent. They have planned to use the conduits of the Providence Telephone Company, but have as yet been unable to come to terms, although the matter is now about to be amicably settled, and undoubtedly all their wires will be buried very shortly.

The municipal police and fire service is all underground in the close fire district, they also using the conduits of the Telephone Company.

It will be seen from the above that the city is now practically clear of overhead wires, with the few exceptions noted. The telegraph wires are comparatively few. Most of them run in overhead cables, and would cause very little trouble in case of fire. The 500-volt feeders of the Union Railroad Company are the only high-tension wires above ground in the center of the city. These are very heavy covered cables, are run on the trolley poles, and are very few in number. As they do not attach to the buildings and are comparatively low, and for the most part of the same polarity as the trolley wires themselves, they are out of the way of the fire department, and do not add to the danger that already exists from having a bare trolley wire in the street. That the placing underground of both high and low tension wires in the city of Providence has proved very satisfactory is shown by the fact that fewer fires from electric causes have occurred in the last two years than ever before, in spite of the fact that almost the entire close fire district is now using the three-wire 470-volt system for lighting, where formerly the 52 and 104-volt systems were in vogue.

With the exception of New York and Boston, no city has so many feet of duct or miles of underground cable as has the city of Providence and the companies are now carrying out extensions in this work with a view to entirely doing away with aerial wire construction inside the city limits. Before introduction of the underground service the Narragansett Electric Lighting Comuany had been using for lighting purposes a 2000-volt alternating circuit which was reduced by transformers at each building to 52 or 104 volts. They now use, as stated above, a three-wire 470-volt system, the two-wire circuits from which using the current at 235 volts. The introduction of this system necessitated many changes in the existing inside wiring and fittings. To overcome this obstacle the Narragansett Electric Lighting Company at its own expense, and under the careful supervision of the insurance authorities have practically rewired the whole of the close fire district of the city. Work has been done in a very thorough manner, strictly in accordance with the Electrical Code, the electric wiring and apparatus in many of the buildings having been completely renewed.

In addition to the foregoing a very satisfactory system of licensing of electrical contractors has been devised and is in operation, licenses only being granted to those parties who, in the judgment of the inspectors of the Insurance Association and the Electric Lighting Company are found upon due examination to be competent. The Electric Lighting Company has agreed not to supply current to any system of wiring that has not been inspected by the Insurance Association of Providence and certificates of approval issued. With such a large proportion of the wiring underground and with the wiring in all the buildings of the close district in such very excellent condition it would seem that the electric light and power service from an insurance standpoint is all that could be desired, and with the harmonious relations now existing between the various electric companies and the insurance authorities the present high standard will undoubtedly be maintained.

Lodge Wireless Telegraphy Patent.

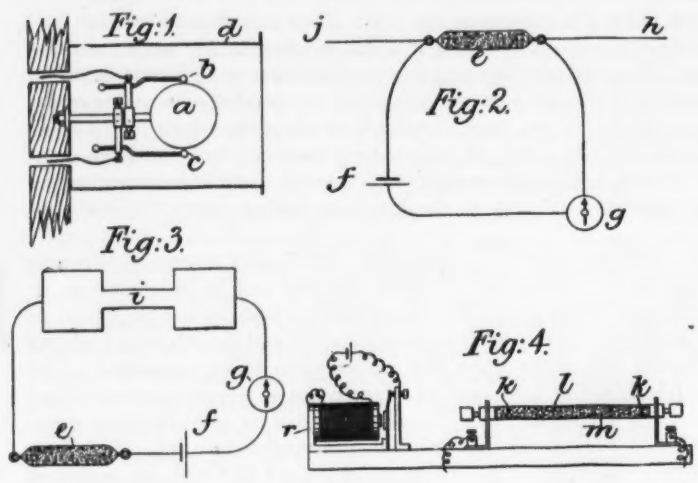
A patent was issued May 21 to Professor Oliver J. Lodge on a wireless telegraph system, the application for which was filed Dec. 20, 1897. The transmitter is shown in Fig. 1. An electric charge is supplied to a single conductor *a* (shown as a sphere, but which may be of dumb-bell or any other shape) suddenly or disruptively by a couple of positive and negative sparks from knobs *b* and *c*, and there left to oscillate and emit waves. A partial metallic inclosure *d* may be used to diminish waves in undesired directions. Both of these arrangements are stated to be the invention of Dr. Lodge. The more usual plan hitherto has been to charge two conductors by a pair of leading-wires and let them spark into each other.

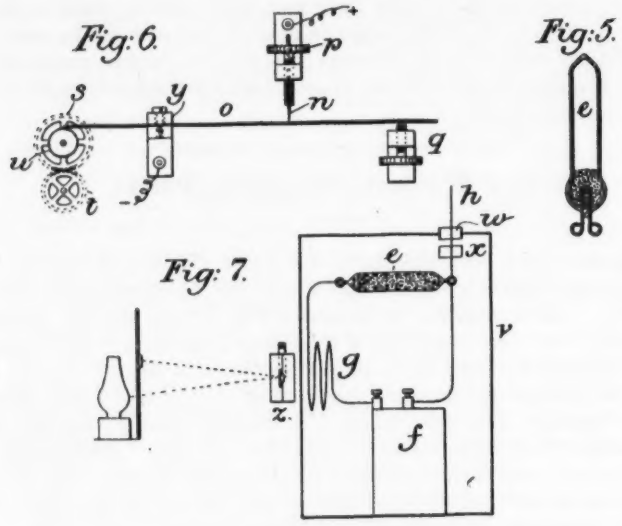
Referring to Figs. 2 and 3, the receiving circuit consists, essentially, of a coherer *e*, a battery *f* or other suitable source of electrical energy, and a telegraphic receiving instrument *g*, all in electrical connection, as shown. There is added to these latter a collecting wire *h*, of any desired length, as shown in Fig. 2, or else a form of Hertzian resonator, as shown at *i* in Fig. 3, the function of either of which is to collect and to convey to the coherer the Hertzian waves produced at a distance, as aforesaid. In some cases any bare wire or a connection to earth direct or through the system of gas or water pipes, as shown at *j* in Fig. 2, will serve sufficiently well as a collector or as an assistance to the insulated collector.

The coherer consists, essentially, of an organism whose electrical resistance diminishes under the influence of Hertzian waves, but which returns to its former amount when the cohered condition brought about by the electrical influence is broken down by mechanical tremor.

One suitable form of coherer is illustrated in Fig. 4, which was introduced (for other purposes) by Branly previous to the year 1894. This arrangement consists of a pair of metallic points *k*, embedded in metallic grains or powder *l* within a glass tube *m*. Or the filings

may be sealed up in vacuum, as indicated in Fig. 5, which increases and prolongs its sensitiveness; or, as illustrated in Fig. 6, a coherer may be used, consisting of a needle-point *n*, resting lightly on a flat plate or spring *o*, fixed in a clamp *y*, the degree of pressure being obtained by the adjustment screws *p* and *q*. On the arrival of Hertzian waves more complete contact or cohesion is set up between the particles of powder *l* or between the point *n* and spring or other light metallic contact *o*, and so allows more current from the battery *f* to flow through the telegraphic receiving instrument (indicated at *g*, Figs. 2, 3 and 7); but then before the coherer is again in a fit state to receive fresh impulses the said cohesion must be destroyed. According to the invention this is effected by an automatic vibrator. This mechanical vibration may consist of a succession of jars or knocks or taps, which may be produced by electrical means, as in an electric trembling bell (see *r* in Fig. 4), or by clockwork. (See Fig.





FIGS. 1 TO 7.—LODGE WIRELESS TELEGRAPHY.

6.) In the last-mentioned figure *s* and *t* represent two wheels of a clockwork train. Upon the arbor (or on a disk mounted thereon) of the wheel *s* is a series of serrations or the like *u* (shown exaggerated in the drawings), which, as the wheel rotates, effects the vibration of the lever or spring *o* either directly or indirectly through the stand. Such a tapper as is used in dentistry also serves very well for my purpose.

A coherer is sensitive not only to the desired impulse arriving from a distance and conveyed to it by the collectors, but it is also liable to respond to any local sparks or electric surgings in its neighborhood, especially to oscillations in an adjacent emitter. It may be protected from all these by complete inclosure in a flawless metallic box.

For the purpose of protecting the coherer from undesired disturbance, therefore, it is inclosed (sometimes with all coils, wires, batteries and the like connected to it), in a metallic covering or case, as shown at *v* in Fig. 7, leaving only one or more round holes or short tubes *w* for the collector terminal or terminals to enter by and for vision or other needful purpose requiring an aperture, for through round holes of moderate size large electric waves do not readily pass, whereas through chinks or long slits, no matter how infinitely narrow, they can pass with ease. They likewise pass in by means of any insulated wire which enters the box; but through any wire which is thoroughly joined to the metal wall of the box where it enters the waves cannot pass.

In the particular arrangement shown in Fig. 7 a single terminal *h* is employed which is insulated from the casing by tube *w* and is connected to one terminal only of the coherer. This construction is effective and desirable in certain cases, and it is found that the Hertzian waves pass in as readily through the single wire, affecting the coherer in the same way as in the case of the earthed circuit through *j* in Fig. 2. Hence it is not absolutely necessary to remove the terminal *h* from its aperture when it is not being used for the purpose of establishing communication and enabling waves from the collector to enter the box and reach the coherer, for these same terminals *h* or *j* may, when they are raised completely, plug with metallic continuity, as shown at *x*, the small holes through which they can freely afterward be lowered.

The only part of the coherer or detector portion outside the box (shown in Fig. 7) is the index or needle mirror *z* of the telegraphic receiving instrument employed, which is acted upon and deflected by its coil *g* inside acting magnetically through the metal wall. When the plan of withdrawing the terminals of the box is adopted, it is sufficient to put the coherer above-mentioned alone in the box.

There are eight claims in the patent, as follows:

1. In a system of Hertzian-wave telegraphy, an emitter consisting of a single conducting body and means for suddenly and disruptively communicating opposite electric charges thereto, whereby oscillations are set up in said body, and waves are emitted; substantially as described.

2. In a system of Hertzian-wave telegraphy an emitter comprising a single conductor supplied with opposite electricities by a pair of knobs connected to the terminals of a high-potential source.

3. In a system of Hertzian-wave telegraphy, the combination with an emitter, of a partial metallic inclosure serving to lessen the emission of Hertzian waves in undesired directions.

4. A coherer comprising a variable electrical contact sealed in vacuum.

5. In a receiver for Hertzian-wave signaling systems, the combination of the following instrumentalities: A coherer, a base or support upon which it is mounted, and a vibrator mounted in proximity to the coherer, and adapted to agitate its elements.

6. In the receiving circuit of a system of Hertzian-wave telegraphy, the combination, with a coherer, of automatic means to successively break down the cohesion caused in said coherer by such Hertzian waves.

7. In combination, in the receiving circuit of a system of Hertzian-wave telegraphy, a coherer, a battery, a telegraphic receiving instrument and automatic means to successively break down the cohesion caused in said coherer by such Hertzian waves.

8. In combination, in the receiving-circuit of a system of Hertzian-wave telegraphy, a coherer, a battery, a telegraphic receiving instrument, automatic means to successively break down the cohesion caused in said coherer by such Hertzian waves, and means serving to collect and convey to the coherer Hertzian waves produced at a distance.

CURRENT NEWS AND NOTES.

WIRELESS TRAIN TELEGRAPHY.—A London dispatch of May 15 states that Signor Marconi has successfully installed his system of wireless telegraphy in a steam motor car, and that he is able thereby to communicate with a base while traveling. The War Office officials are about to witness a demonstration of the apparatus.

TELEGRAPH WIRES LAID ON SNOW.—Consul-General Guenther, of Frankfort, says that, according to experiments conducted by Mr. H. Janssen on Mont Blanc, it is not necessary to erect poles for stringing telephone and telegraph wires in snow-covered countries. If the snow is several inches thick, it serves as a good insulator; the wires can simply be laid down and be ready for transmission of messages. The consul-general adds that similar experiments with equally favorable results were made on Mount Ætna.

ELECTRICITY IN JAPAN.—According to a recent consular report the Japanese investment in electric lighting in 1899 was $3,954,000, an increase of no less than $2,378,000 over 1895.

NEW YORK ELECTRICAL SOCIETY.—At the meeting of the New York Electrical Society, May 16, the following members were elected: Messrs. David Rousseau, C. J. Spencer and W. C. Gotschall.

THE LIVERPOOL & MANCHESTER ELECTRIC RAILWAY.—According to a cable dispatch from London on May 17, the committee of the House of Lords passed the Mono Railway bill, which authorizes the construction of an electric express railway between Liverpool and Manchester.

UNDERWRITERS' RULES.—The National Board of Fire Underwriters has issued a 42-page pamphlet containing the rules and requirements of the board for the installation of automatic sprinkler equipments, as recommended by the National Fire Protection Association. A section of the pamphlet is devoted to rules and regulations governing wiring for electric alarms.

PARIS-BRUSSELS ELECTRIC LINE.—A Belgian newspaper announces that King Leopold intends to create a network of electric railways, requiring a capital of 1,000,000,000 francs, to be constructed in the following order: Brussels to Antwerp, Brussels to Ostend, and Brussels to Paris. According to the same authority the consent of the French Government has been secured.

RAPID TRANSIT TUNNEL TO BROOKLYN.—Both branches of the New York Municipal Assembly have approved the plans of the Rapid Transit Commission for the tunnel to Brooklyn, and all that is necessary now for the beginning of the construction of the tube is the appropriation of the $8,000,000 by the city to pay the expenses of the work, and the letting of the contract.

WIRELESS TELEGRAPH EQUIPMENT ON STEAMER.—A Liverpool dispatch dated May 21 states that the steamer Lake Champlain, the first British vessel to be equipped with the Marconi system of wireless telegraphy, has sailed from that port for Montreal. She will try to communicate with the shore two days after leaving the Mersey and two days before she reaches Quebec.

ITALIAN SUBMARINE BOAT.—Rear Admiral Micheli, Inspector-General of Italian Naval Engineers, has presented to Vice-Admiral Morin, Minister of Marine, plans for a new submarine war vessel which he says will be vastly superior to anything yet invented. He will undertake to build a vessel of 160 tons displacement and a speed of 12 knots an hour, and capable of remaining under water for a long time.

WIRELESS TELEGRAPHY TESTS.—Recent experiments in wireless telegraphy off the coast of Malta have resulted in the successful transmission of a message 134 miles, according to United States Consul Grout at Malta, in a report to the State Department. The message was received in an unexpected way. While experimenting on a ship in the open sea the operators were surprised to rceive a message in Italian asking as to the position of their ship. It afterward developed that the message came from an Italian war vessel at Syracuse.

A WESTERN SIROCCO.—A heavy windstorm swept over Nevada, Utah, southern Iado and Wyoming last week, the velocity at times reaching 50 miles an hour. The storm has resulted in the complete prostration of telegraph and telephone service in all directions. Reports from outside cities tell of uprooted trees, wrecked outbuildings, interrupted electric service and other damage. The storm was particularly severe through Nevada and Utah, and in places across the desert the blowing sand almost buried the railroad tracks for miles. Around Great Salt Lake a perfect sirocco prevailed.

ROWLAND TELEGRAPH IN GERMANY.—According to a Berlin dispatch experiments have been made between Berlin and Hamburg during the past month, with the system of rapid telegraphy of the late Professor Rowland, of Baltimore. The results are said to have been most satisfactory, the news system easily doing double the amount of work done by the Baudot apparatus. It is understood that the German Postal Department intends to introduce the Rowland system between Berlin, Hamburg, Cologne, Leipsic and Frankfort.

A SOUTH AMERICAN TELEGRAPH.—A Lima telegram states that a proposal has been received in Peru from the Argentine Government, for the construction of a telegraph line from the Argentine Republic across Bolivia and Peru to Ecuador, where it should connect with the line to Central America and the United States. This, it is stated, would obviate the necessity of the South American Republics depending solely upon the English and French cables on both the Atlantic and Pacific coasts for their telegraphic communication with the United States.

TRYING A DIVORCE CASE BY TELEPHONE.—An Indianapolis correspondent calls our attention to the part played by the telephone in a recent divorce case at Noblesville, Ind. A Mrs. Nagle brought suit for divorce. On the day appoitned for the trial her attorney, Mr. Fippen, could not attend, and called up the Noblesville judge and explained the circumstances, suggesting that the case be tried by telephone. The Judge consented, the witnesses were sworn, and in answer to questions asked them by Mr. Fippen, 30 miles away, submitted their testimony to the Judge, after which Mr. Fippen delivered his argument, talking into the Judge's ear by telephone. The divorce was granted.

ELECTRICAL FIRE LOSSES.—The electrical bureau of the National Board of Fire Underwriters reports numerous losses during the last quarter. These aggregate more than $1,361,000, but since the origin of some fires could not be ascertained with accuracy, particulars in all cases are not given. The report cites these incidents: Four fires caused by sparks from motors occasioned loss of $11,714, and in one case a total loss, the amount of which was not recorded. Seven fires are reported of breakdowns in motors. Thirty-three incipient fires and burnouts are reported as due to defective wiring and general breakdown of insulation, mostly on old work. Three fires each, due to sockets and flexible cord, show that the standardization of these articles has not been without effect in reducing the losses occasioned by their use. Eleven cases of grounds on awnings and guilding fronts are recorded. Three losses are on file due to overheating of rheostats and motor-starting boxes. Three losses are noted as caused by the breakage or heating effect of incandescent lamps. Four fires are traceable to defective chandelier switches. Three cases are noted where fires have started by arcing between water and gaspipes, caused by a difference of "potential" between them, produced by breakdowns in Edison underground service wires. Nine burnouts and crosses reported as occurring during wind and sleet storms emphasize the necessity of placing wires underground.

ELECTRICITY AND POPULATION.—In an interesting article in the *Fortnightly Review,* Mr. H. G. Wells notes the centrifugal effects of electric traction as follows, but overlooks the centripetal: We are on the eve of a great development of centrifugal possibilities. And since it has been shown that a city of pedestrians is inexorably limited by a radius of about four miles, and that a horse-using city may grow out to seven or eight, it follows that the available area of a city which can offer a cheap suburban journey of 30 miles an hour is a circle with a radius of 30 miles. And is it too much to expect that the available area for even the common daily toilers of the great city of the year 2000, or earlier, will have a radius very much larger even than that? Now, a circle with a radius of 30 miles gives an area of over 2800 square miles, which is almost a quarter that of Belgium. But 30 miles is only a very moderate estimate of speed, and the reader of the former paper will agree, I think, that the available area for the social equivalent of the favored season-ticket holders of to-day will have a radius of over 100 miles, and be almost equal to the area of Ireland. The radius that will sweep the area available for such as now live in the outer suburbs will include a still vaster area. Indeed, it is not too much to say that the London citizen of the year 2000 A. D. may have a choice of nearly all England and Wales south of Nottingham and east of Exeter as his suburb, and that the vast stretch of country from Washington to Albany will be all of it "available" to the active citizen of New York and Philadelphia before that date.

WIRELESS TELEGRAPHY IN PULPIT.—Rev. C. H. Tyndall, of the Dutch Reformed Church at Mount Vernon, N. Y., a couple of Sundays ago, illustrated his sermon on "Wireless Telegraphy and its Spiritual Similitudes," with a complete operating wireless telegraph equipment. He compared the electric waves to the penetrating but invisible influences of the Diety.

LONG-DISTANCE TELEPHONY.—According to a Boston financial journal, satisfactory tests of the Pupin system of telephony have been made between Chicago and New York, and showed that with this system a line weighing 314 lbs. to the mile gave as good results as an ordinary line weighing 870 lbs. to the mile. The same journal states that a circuit for commercial use will soon be established between New York and New Orleans, which will make conversation practicable between New England and Galveston and all Texas points.

HIGH VOLTAGE IN INDUCTIVE EFFECTS.—A correspondent writes that while in the Western Union office at Reno, Nev., recently he noticed a very pronounced hum above the noise of the instruments. Upon inquiry he was informed that the Blue Lakes Power Company was testing its line and that this inductive effect was the result. It was also stated that the line was at the time being experimentally tested at 85,000 volts, the line being about 170 miles distant from Reno. The noise, which was most disagreeable, would rise to a certain pitch and then fall to a lower pitch as if the generator was racing.

LEHIGH ELECTRICAL THESES.—Among the subjects of theses to be presented by the candidates for degrees from Lehigh University are the following: "Theory and Calculations of the Induction Motor," by P. L. Anderson and L. A. Freudenberger; "Induction Wattmeter Tests," by W. D. Cassin and J. C. Ryan; "Theory and Calculation of Alternating-Current Transmission Lines," by J. H. Flory and C. W. Startsman; "Conductivity Tests of Copper," by E. S. Harrar and G. W. Welch; "Resistance Standards," by A. C. Savidge and J. S. Van Alen; "A Gravity-Driven Electric Power Plant," by F. Donaldson.

MUNICIPAL ELECTRICIANS.—The International Association of Municipal Electricians will meet in the Natural Food Company's convention hall at Niagara Falls, N. Y., on September 2, 3 and 4. Mr. F. C. Mason, of Brooklyn, N. Y., has made special arrangements whereby all delegates and visitors can secure greatly reduced railroad fare, who go via New York City. For full information, address F. C. Mason, superintendent police telegraph, 16 Smith Street, Brooklyn, N. Y., giving the number you will have in your party. Mr. M. J. Donohue, superintendent of fire telegraphs, can be addressed as to local accommodations.

ELECTROLYTIC PURIFICATION OR CRUDE SPIRITS.—In a patent granted May 21 to J. H. Lavollay and G. E. Bourgoin, of Paris, France, a process is described for purifying crude spirits to obtain neutral rectified spirits. The process consists in treating the crude spirits until neutralized with a manganate of an alkaline earth metal in the presence of an electric current. Manganate of calcium or any other insoluble manganate may be employed. The result of the process consists in the elimination of bad flavors, in an improved product, and the reduction of aldehydes by means of electrolytic hydrogen. The quality of the spirits is thus improved, and the yield of resultant spirit increased.

ACETYLENE CONVENTION.—The International Acetylene Association will meet at Buffalo, N. Y., June 20, 21 and 22, when the following programme will be presented: "Purification of Acetylene," G. W. Kuchler, with the Roessler & Hasslacher Chemical Company, New York City, N. Y.; "Acetylene Heaters & Cookers, and Their Application," A. T. Murdock, secretary American Acetylene Stove Company, Minneapolis, Minn.; "Town Lighting," Emory S. Turner, New York City, N. Y.; "The Future of Acetylene Gas," George Landis Wilson, of F. Cortez Wilson & Co., Chicago, Ill.; "Relative Merits of Acetylene & Gas Lighting," William Finkler, of W. Finkler & Co., Chicago; "Results of Practical Experiments with High-Pressure Lighting," Harvey T. Hauer, with Lebanon Fuel Illuminating & Power Company, Lebanon, Pa.; "Acetylene as Applied to Locomotive Headlights," McDonald Elliott, Santa Rosa, Calif.

CLOSE OF N. Y. ELECTRICAL SOCIETY SEASON.—Secretary Guy, 120 Liberty Street, New York, has issued the following notice: The twentieth annual meeting of the New York Electrical Society for the election of officers, will be held at the Cafe Boulevard, Second Avenue and Tenth Street, Thursday, June 6, at 9 p. m., to be preceded at 6.45 p. m. by an informal banquet—tickets $1, without wine. The meeting and dinner will be followed by an entertainment in the place of speeches. An excellent menu has been specially provided, and it is hoped that every member will make an effort to attend, to participate in this pleasant close to a very successful season. With the object of studying the convenience of many of the members who are unusually busy at this season of the year, the executive committee requests that members will come straight from their offices and that no evening dress will be worn. Members must give prompt notice on accompanying postal of their intention to be present, as a large attendance is already assured, and it is necessary that the secretary should be fully advised as to how many of the members and their friends must be provided for.

MULTI-SPEED POLYPHASE MOTOR.—A patent granted May 14 to B. G. Lamme relates to means whereby the speed of a polyphase motor may be readily varied. The motor is of the direct-current type—that is, has a commutator armature. The armature is supplied with current from one leg of a two-phase circuit, and the field with current from the other leg, transformers being interposed between the motor circuits and line. The secondary of each transformer is sectional, and means are provided to vary the number of active coils, thereby varying the voltage of either the field or armature, or both. In addition the field circuit contains an adjustable ohmic resistance, and the armature circuit an adjustable inductive resistance. In order to vary the speed of the motor, the e. m. f. supplied to the armature may be varied by cutting in or out secondary coils, or both the field and armature e. m. f.'s may be varied by adjusting the secondaries of both transformers. The speed may also be varied, if desired, by adjusting the phase angle between the currents in the field and armature, this being done by adjusting either the ohmic resistance in the field circuit, or the inductive resistance in the armature circuit, or both. All the adjusting devices above referred to will probably not be used in practice in any one installation.

TECHNICAL EDUCATION.—The April issue of the University of Tennessee *Record* contains an article by Mr. A. C. Lanier on "Technical Education in the South." The growing industries of the South are sketched and the need pointed out for technical courses in the Southern schools to meet the situation. The Georgia Institute of Technology and Clemson Institute in South Carolina have recently instituted courses designed to prepare men for the textile industry, and a plea is made for an increase in the scope of the courses of the University of Tennessee. In discussing the methods of technical education Mr. Lanier points out that specialization should not mean narrowness. The engineer of to-day, he says, requires a broad culture. He has been looked upon as a man of wood and iron, and only with reluctance admitted within the "charmed circle of the learned professions." Of all men the engineer must see "long perspectives and wide horizons"; his whole training should "lift him above bias and prejudices, fit him to balance facts against forms, to eliminate non-essentials, draw up correct conclusions and to seek consequences from premises." Though nature is his workshop, human nature is his most important tool, and studies which will develop the social side of his character should find a prominent place in his education. Recognizing this need many leading educators have recommended that he take a course in literature, history and social economics, together with some mathematics, languages and general science, continuing through two or three years, before entering upon his more specialized work.

LETTERS TO THE EDITORS.

The Wheeler Gift.

To the Editors of Electrical World and Engineer:

Sirs.—The recent gift of the Latimer Clark library to the Institute of Electrical Engineers by Dr. Schuyler S. Wheeler, leads me to ask space for a few words based on my own experience in endeavoring to create a wider knowledge of electrical history among the members of the electrical profession.

At the outset, permit me to differ with you in your statement that now for the first time in this country a historical collection of this sort will be freely open to all interested. I think you overlook the fact that my collection, since given to the United States Naval Academy, was freely open for more than six years. It was placed in a separate room adjacent to my office and provided with a separate entrance. I took every means possible to inform the members of the electrical profession that not only was it open to their use, but that it would afford me great pleasure to have them use it.

The number of people who availed themselves of this offer during the period of six years above mentioned was *just two;* and I don't think that the researches of either extended over more than a few hours. It is true that some individuals—and, of all, the first and foremost was yourself—did manifest a gratifying and, needless to say, intelligent interest; but it is none the less a fact that the great majority of people who looked at the books viewed them with an appreciation apparently no different from that which they would have accorded to any other collection of out-of-the-way objects.

Always excepting the individuals above mentioned, I found by actual experience extending over 12 years that the particular book which happened to bear the earliest date invariably aroused greater interest than others of later epochs, although many of the latter were far more rare, or historically important. If the title pages and pictures of the books were displayed in a public exhibition, as they were here in New York in 1896, they were looked at, but even in this case I failed to discover that the interest they excited in the electrical profession was any greater than that accorded to them by the general public, and in some instances by people in walks of life far removed from any connected with electricity.

At various times I attempted to stimulate the attention of electricians to the beginnings of the science, not merely because of my own interest in it, but because I had found that the actual facts concerning early invention and discovery had been almost constantly misstated, especially in cyclopedias. This was due evidently to two causes. First, the great scarcity of the old original publications, and, second, the tendency to accept the statements of Priestly's history, published in the last part of the eighteenth century, as conclusive concerning all preceding achievement. There never was a more broken reed on which to rely. It was a compilation put together in less than a year, under many distractions mainly arising from theological controversies, and where not based upon the few and easily accessible transactions of learned societies, founded upon a comparatively limited number of original treatises which the author borrowed from Benjamin Franklin. To the inadequacy of his material the author himself was fully alive, for he gives a list of the books which he had consulted, and adds thereto another list of books which he was unable to obtain, thus giving the clearest warning that his field had only been partially winnowed.

It was my good fortune to possess not merely every book which he said he had consulted, but nearly every one which he said he could not get, besides many others which he does not mention at all, and apparently knew nothing of, besides others again in which no one, at that time, even suspected that electrical discoveries were buried; and on that basis I ventured to correct many misconceptions which later writers had assumed as accurate truth. The effort was not successful. The actual words of the original discoverors were, time and again, triumphantly refuted by statements drawn by my erudite critics from cyclopedias sometimes two centuries later in date. Since then the old errors have been no less infrequently reiterated in many a so-called "historical retrospect." Nor have I been able to discover that the labors of others who have attempted to throw open the hitherto closed doors of electrical history have met with any better fate. Dr. Silvanus Thompson's long-promised translation of Gilbert has not appeared. The proposed tercentenary celebration of the advent of Gilbert's great work did not occur in 1900. Most of the copies of Mr. Mottelay's translation of the "De Novo Mundo" still, I think, remain on the shelves of his publisher, and I am informed that the German fac-simile reproductions of Greene and Gilbert have proved far from remunerative.

In brief, if 12 years of study of the subject, coupled with persistent attempts made by others as well as by myself, to popularize it in the electrical profession prove anything, it is that no interest whatever, save in so few instances as to be practically inconsiderable, or at least has hitherto existed among electrical workers concerning electrical history. At the time I was engaged on my own book, one individual remarked to me that the effort would be much better directed to the production of "a practical hand-book on winding dynamos, to sell for 50 cents." I am not sure that he was not right.

The cause of all this is not far to seek. I do not lay it to any general lack of appreciation; still less do I consider it any ground for complaint. The electrical profession is of new growth, and scarcely dates back a quarter of a century. Every one in it has been called to grapple with new ideas and with the endless problems arising from the adaptation of them to immediate practical and commercial uses, and this, in most cases, as a means of livelihood; in fact, there have been comparatively few in the past who probably could give the time to such study. It is no disparagement to these earnest and energetic workers to say that probably also there were many of them whose early education had not implanted in them a full appreciation of its utility.

Perhaps all this is now changing, and to Dr. Wheeler may be due not only the great credit which attaches to his generosity, but the even greater honor of recognizing that a broader spirit of culture is now showing itself among the electricians of this country. If the future use made of his library shall show that he is right, he has conferred a benefit upon his profession which can hardly be overestimated.

PARK BENJAMIN.

NEW YORK CITY.

Electrolytic Rectifiers.

To the Editors of Electrical World and Engineer:

Sirs.—With reference to the discussion of the modus operandi of the Pollak rectifier, may I be permitted to say that the reason of the action is no longer a matter of theory, but was definitely settled by me about four years ago, and the results formed the subject of a paper read before the American Association for the Advancement of Science in, I think, 1898.

I had two of my students, whose names I unfortunately cannot remember at the moment, take curves at various points in such a cell, i. e., between one plate and solution, other plate and solution, different portions of solution, etc. From these curves the phases of the current and voltage in different parts of the cell were computed, and also the instantaneous differences of potential. It was found that a high drop of voltage, 10 to 20 times what could be given by any polarization counter voltage, occurred within a few thousandths of the surface of the aluminum plate, and that the layer was possibly even thinner, this distance being as close as mechanical conditions would permit. It was also found that the current between this point and the aluminum plate was entirely a leading one, when the plate was working efficiently, and that therefore the effect was due to a capacity, in turn due to the formation of a thin insulating layer. With excess of voltage this thin film would break down in points and minute arcs would appear. It was also shown that the decomposition taking place at each period was sufficient to form an insulating layer having a capacity equal to that which the leading current showed and was actually present.

In this connection I would make a suggestion, or, rather an inquiry. The meetings of the scientific associations on this side of the water are very meagerly reported if at all. As regards the purely technical meetings, the exact opposite is the case, as witness the splendid reports made by the ELECTRICAL WORLD AND ENGINEER of the Electric Light and other associations. Could not the same be done with, for example, the electrical papers of the American Association of Science and the Physical Society? The present method of presenting the results of these meetings is entirely insufficient. A few years ago I had the honor of being secretary of the Physical Section of the American Association. I found that the reporting of the proceedings was in the hands so far as I could find out of one man only, and, though however thoroughly qualified he might be, he naturally could attend to only a small percentage of the papers. In a laudable endeavor to accomplish the impossible, he would then come around to the different secretaries and sponge on them for abstracts of all the papers which had been read during his absence. As many of the secretaries were hard worked (to take my own case, I had a number of times to go without my meals), they frequently found it impossible to accommodate him, with the result that he apparently conceived that he had a grievance against them for not doing the work for which he was paid, and work which was entirely aside from the duties of the secretaryship; and he apparently considered the assistance freely given him, often at considerable personal sacrifice, as a right and not as a voluntary contribution.

If some arrangement could be made by the scientific and technical papers, jointly, perhaps, for the full reporting of these meetings, a number of papers containing facts of considerable interest to the engineering professions would be placed in accessible form, whilst at present they are, as a rule, not so placed.

MANTEO, N. C. REGINALD A. FESSENDEN.

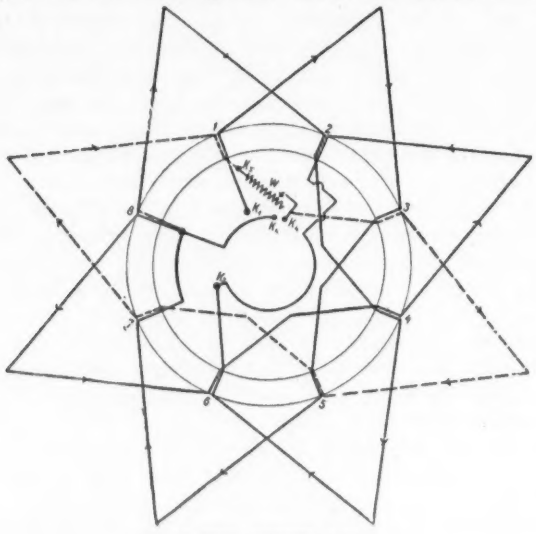
[We have repeatedly referred to the entirely inefficient organization with respect to publicity of the American Association for the Advancement of Science, which defect reduces to a minimum the usefulness of that body in the advancement of science. On occasions when this journal has had a special representative at a meeting, it was found impossible to prepare a satisfactory report, and in at least one instance obstacles were actually interposed. As many of the papers presented at a meeting are only printed in the *Transactions* by title or in brief abstract, the Association with its present press organization might not inaptly be entitled the "American Association for the Suppression of Scientific Knowledge."—EDS.]

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Alternators.—GILES.—A long, theoretical article on the "Predetermination of the voltage drop in alternators and the action of the so-called amortisseurs." He reaches the following conclusions. All alternators, not provided with a perfect amortisseur, have in the e. m. f. during load, and, hence also in the current, a third harmonic even if the e. m. f. at no-load is strictly sinusoidal. The most important part of the voltage drop is not due to the self-induction of the alternator. The e. m. f. of self-induction, i. e., the e. m. f. due to the flux interlinked with the armature coils without passing through the field spools, is always small and does not exceed 8 to 10 per cent of the normal voltage of the alternator. The total voltage drop consists of two parts: The first is due to the self-induction, while the second is a function of the ampere turns, the reluctances of the air gaps and of the stray circuits of the field, and the internal phase displacement of the alternator. For the operation with a completely wattless current, it is feasible, as Potier has shown, to go from the characteristic curve for no-load over to that for load by displacing all points of the former curve by a constant number of ampere turns and a constant number of volts. These numbers may easily be predetermined. This result cannot be applied to other power factors. In a short-circuited alternator the e. m. f. is not in quadrature with the current. The e. m. f. of self-induction has a value well comparable with that consumed by ohmic resistance. All characteristic curves, plotted for the same output but for different phase differences at the terminals, start from the short-circuit point. The diagram for the operation of an alternator as generator represents also its operation as synchronous motor with constant current, but as it is in general necessary to examine the operation of the synchronous motor at constant voltage and constant excitation, it is necessary to use another diagram. By the application of the amortisseur in alternators the drop of voltage is considerably diminished.—*L'Eclairage Elec.*, April 20, 27.

Starting Single-Phase Induction Motors Under Load.—OSNOS.—An article, illustrated by diagrams. He thinks that the methods devised so far for starting single-phase induction motors were wrong in so far as they produce an artificial phase, differing by just 90 degs., which he considers superfluous. As this can be done only in an artificial and complicated manner, the current produced must be small. He suggests the following method of starting, in which he uses only a non-inductive resistance. After the motor has run up to normal speed, the connections are changed over to the normal ones. In the adjoining diagram a four-pole stator winding is shown. $k_1\ k_2\ k_3\ k_4$ are terminals for making connections, and W is an adjustable non-inductive resistance. The primary circuit is connected to the terminals k_1 and k_2. If k_3 is connected with k_1 and k_4 with k_5, this is an ordinary single-phase winding with two parallel circuits. This corresponds to the connections at normal service. If, however, the connections are made as shown in the figure, the dotted conductors, which form a closed circuit through the non-inductive resistance, are the secondaries of a transformer, the conductors, represented by straight lines and placed in the same grooves, forming the primary windings. At the grooves 1, 3, 5, 7 a combined field is produced which has a certain phase difference against the primary field at the grooves 2, 4, 6, 8. This phase difference can, by regulating the non-inductive resistance, be made 45 degs., which he finds to be the most favorable angle. He compares this motor with an ordinary two-phase induction motor of the same size, and finds that for equal primary e. m. f. the starting torque in his motor is smaller than in the two-phase motor by only 20 per cent. The energy required in his motor is 1.6 times that in the two-phase motor. During starting the primary winding of the artificial field is loaded with double the current of the main field. He has not tested this method experimentally.—*Zeit. f. Elck.*, April 21.



STARTING UNDER LOAD.

Polyphase Working.—EBORALL.—An abstract of his second lecture on this subject. He pointed out the influence of the wave-form factor on the e. m. f. of the machine. The calculation by Kapp of the ratio of pole-width to pole-pitch, on which this wave form factor depends, gave too high a figure, as he did not allow for the spreading out of the lines at the pole face, and he assumed the width of the connecting wires between the actual useful winding to be zero. He gave some data, among which were that the ampere-wires round the periphery of the armature per centimeter, should not exceed 200, and that the iron losses in a good machine are generally 40 per cent greater than the copper losses, because of forcing the magnetism in the teeth. He obtained a simple expression for the reactive ampere-turns. Assuming the phases to be exactly at 120 degs. and also a sine wave form, these should be calculable by the formula 1.5 by 1.41 by ampere per phase by turns per phase, but in reality the numerical constant becomes something between 2.2 and 2.4 instead of 2.12. He discussed the method of determining the requisite ampere turns on the field magnets by vector diagrams. The magnet ampere-turns required for compensating the armature reaction are easily ascertained for any particular design of machine by short circuiting it and noting the amperes passing through the field coils, and the circuit of one of the armature phases. The ratio of the observed field ampere-turns to the observed armature-turns, which varies from 2.5 to 3.5 is what is thus obtained. Similarly, a good method of computing the field and armature leakage, and the extra ampere-turns required to make up for them, is to run the machine up to speed and connect choking coils to it until it delivers the full-load current. Then by noting the field current, voltage and output current, and taking the no-load and short-circuit characteristic, a simple graphical construction gives the quantities required, which may be used in designing any other machine with the same ratio of pole-breadth to pole pitch.—Lond. *Elec.*, May 10.

Testing Three-Phase Machines.—BRESLAUER.—An abstract, illustrated by diagrams, of a paper read before the Electrotechnical Society, of Vienna. In the laboratory it is, in general, impossible to make exact tests of three-phase machines for non-inductive loads. It is usual to determine the no-load and the short-circuit curves and to draw therefrom conclusions as to the constancy of the pressure for different loads. He gives an example from the practice, which clearly shows that this method is correct, and that conclusions drawn in such a way agree with the facts. In the special case which he mentions, the voltage drop for full non-inductive load had been found by calculation from the curves to be 40 per cent, and this very great value was also found in the experimental test by means of water resistance. In the central station which was equipped with these generators with that enormous voltage drop, and which furnished power for lighting and power, it had been found to be impossible to maintain a regular satisfactory service, as the voltage variations were extremely troublesome.—*Zeit. f. Elek.*, April 14.

Seefehlner.—An illustrated article on the same subject. He has tested an old machine with bad regulation, and has also found that the measurements agree fully with the theory.—*Zeit. f. Elek.*, April 28.

Alternators in Parallel.—A review of the progress of work of a special committee of the Internat. Soc. of Elec. in Paris, on the connection in parallel of alternators driven individually by steam engines. The coefficient of irregularity of a steam engine is suggested to be defined as the difference of the maximum and minimum speed of the machine, divided by the average speed. Other subjects to be treated are the theoretical and the experimental determination of the coefficient of irregularity of different loads, the maximum value of this coefficient admissible for lighting networks and for power networks, and its variations with the frequency, the influence of this coefficient upon the operation of alternators in parallel, further questions regarding starting, electromagnetic resonance, and sudden changes of load.—*L'Ind. Elec.*, April 25.

REFERENCE.

Induction Motor Diagram.—SUMEC.—An article, illustrated by diagrams, in which he develops the Ossanna diagram for induction motors under consideration of the primary voltage drop, and shows how to find from it the torque, the slip and the efficiency.—*Zeit. f. Elek.*, April 14, 21.

LIGHTS AND LIGHTING.

Nernst Lamp.—An illustrated description of a system patented by the Gen. Elec. Co., of Berlin. As the heating of the filament of the Nernst lamp takes about 15 to 30 seconds, before it is lighted, it is proposed to combine one or more ordinary incandescent lamps with the Nernst lamp, and a device by which the ordinary incandescent lamps are automatically disconnected when the more economical Nernst lamp is lighted up. Several devices based on this principle are described and illustrated in diagrams.—*Zeit. f. Beleucht*, April 30.

Arc Lamp.—An illustrated description of the "Regina" enclosed arc lamp, made by a German company. The life of the carbon is said to be 160 to 180 hours, the temperature of the arc 4500 degs. The carbons are enclosed in a narrow cylindrical glass tube which is enclosed in the lamp globe. This space is in connection with the external atmosphere only by a small perpendicular pipe, extending into the lower part of the lamp. The oxygen of the lamp is quickly consumed and a mixture of carbon monoxide, carbon dioxide and other gases is formed. The hot gases which are formed rise in the lamp on account of their low specific gravity. At the same time the heavier air of the atmosphere is sucked into the lamp very slowly and gradually through the thin pipe. In this way a very regular and continuous, but very slow supply of oxygen to the lamp is said to have been obtained.—*Elek. Rund.*, April 15.

REFERENCE.

Electric Light.—DE FODOR.—A lecture held before the Electrotechnical Society of Vienna, on "The light of the future." He gives a review of recent development in incandescent and arc lighting, and of experiments with vacuum tube lighting.—*Zeit. f. Elek.*, April 7, 14.

Direct and Alternating-Current Systems for Power Distribution in Factories.—GOLDSBOROUGH.—An abstract, illustrated by diagrams, of a lecture held before the Cleveland Electric Club, on "The relative performance and efficiency of direct-current and induction motors." He compares the two systems on the basis of a uniform maximum potential of 500 volts, and on the basis of the same weight of copper being used in the lines. He reaches the following conclusions: In point of construction the direct-current motor and the induction motor are on very equal terms. In point of weight, the alternating-current machine has the advantage. In point of full-load efficiency and equivalent currents taken at full load there is some advantage to be credited to the direct-current machines. In point of efficiency at medium loads, the average performance of standard commercial machines shows that the alternating-current motor has the advantage over direct-current motors. At these loads, however, the equivalent line currents taken by the alternating-current motors are considerably in excess of the currents taken by direct-current motors. In point of starting torque, the direct-current motor is undoubtedly superior to the alternating-current motor for exceptionally heavy duty. Against this advantage of the direct-current motor must be placed the elimination of the commutator in the alternating-current motor, which, in some cases, at least, might make it worth while to install a 20-hp induction motor in order to obtain the required starting torque, where otherwise a 10-hp direct-current motor would suffice. In this comparison no consideration has been taken of the advantage which the alternating-current motor has over the direct-current motor, which is given to it by the possibility of its being operated from high-voltage mains.—*The Eng.*, May 15.

REFERENCES.

Australian Plant.—A brief illustrated article on the power plant of Kalgoorlie, in Western Australia. There are great difficulties, as no fresh water is to be obtained there, all available water being a dense solution of salt and other mineral matter, and even this water is not plentiful. This water can be used in boilers only after distillation, so that in addition to the high-pressure boilers a complete set of low-pressure or evaporating boilers is required with condensers. The electrical apparatus for the plant will be of the three-phase alternating-current type, manufactured by the General Electric Company of this country.—Lond. *Elec. Rev.*, May 3.

Belt-Gearing.—SCHINDLER.—An article on the friction loss with belt-gearing.—*Elek. Anz.*, May 2.

Electric Power on the Stage.—An illustrated description of the electric stage mechanism at the Covent Garden Opera House in London.—Lond. *Elec.*, May 10.

TRACTION.

Electric High-Speed Railroads.—REYMOND-SCHILLER.—The first part of an article in which he speaks in favor of an international European Congress for defining precisely and discussing the question of high-speed long-distance railways through Continental Europe, the speed being assumed at 150 miles per hour. He thinks that the tramway system with single cars cannot be used, but that regular trains should be run, with an electric locomotive and, say, three trailers. In the latter the electric installations (for lighting, heating, signals, etc.) should be such that they can be used as well for direct current as for three-phase current, etc., as different systems may be used in different countries. He therefore suggests keeping the electro-mechanical part of the train entirely separate from the part serving for traffic. He suggests having two classes of trains running, one for long-distance trips, the others for local traffic.—*Zeit. f. Elek.*, April 28.

Electric Boats.—EHNERT.—An article on the commercial practicability of electric boats, compared with steam boats. Electric boats can compete with the latter only for local traffic, with not too extended trips. The Plante type of storage battery, although heavier and more expensive, has proved more satisfactory for electric boats than the Faure type. He compares the annual cost of maintenance of an electric and a steam boat of equal size and equal speed, the duration of the trip being assumed at 1000 hours, and the first cost of the electric and of the steamboat, at $3,500 and $2,500, respectively. The annual cost of operation of the electric boat, including interest and amortisation, is calculated to be $1,096, that of the steamboat is $1,154, so that, if a yearly income of $1,500 from the boat is assumed, the capital invested in the electric and in the steamboat yields an interest of 11 per cent and 13.8 per cent, respectively. Special advantages of the electric boat are its freedom from smoke and vibrations. For special purposes, for instance, for police duties in a harbor, the operation of an electric boat is much cheaper than that of the steamboat. Both boats must always be ready for service, but the steamboat always consumes fuel, while the electric boat does not consume energy as long as it does not run.—*Elek. Anz.*, April 25.

REFERENCE.

Electrolysis from Return Currents.—Jastrow.—A communication in which he shows that the method of the measurements in Krohn's investigation (Digest, May 4) is not correct, and may cause appreciable errors.—*Elek. Zeit.*, May 2.

Installations, Systems and Appliances.

REFERENCE.

High-Tension Alternating-Current Switch.—Bainville.—An illustrated description of a switch, devised by Mornat and Langlois, for breaking high-tension alternating-current circuits. It is said to have proved satisfactory in practice. It is made as double-pole or three-pole switch. The instrument is based upon the breaking of the circuit in a layer of oil. Several types of the switch are shown in diagrams. —*L'Elec., May* 4.

Wires, Wiring and Conduits.

REFERENCE.

Equalization Mains.—Edelstein.—A communication referring to Teichmueller's article (Digest, May 4), and giving some analogous formulas.—*Elek. Zeit.*, May 2.

Electro-Physics and Magnetism.

The Nature of Coherer Action.—Guthe.—A description of the following experiment made to study the coherer action. Two fine wires of the same metal are mounted at right angles to each other and brought into contact. A current was then sent through one of the wires, so as to heat the contact. During the heating a current was sent from one wire to the other. It was found that under otherwise equal conditions the resistances of the contact was the smaller the hotter the contact, and that the resistance returned to its original value on stopping the heating. He believes that the first stage of the coherer effect consists in the heating of the junctions between neighboring particles. But another process must take place as well, since the coherer does not recover its original resistance at once, whereas the wire junction does. If the coherer consists of mixed metals, and bismuth is one of them, the junction between bismuth and the other metal is heated rapidly, since bismuth is a very bad conductor of heat. This effect may sometimes be marked by a Peltier effect, since the heating of the junction between the bismuth and the other metal may give rise to a current opposed to a main current traversing the coherer.—*Ann. der Physik*, No. 4; abstracted in Lond. *Elec.*, May 10.

Resistivity of Pure Metals.—Van Aubel.—A criticism of the various values put forward by Dewar and Fleming for the resistivity of bismuth, nickel and tin. Nickel prepared from nickel carbonyl shows very nearly twice the resistivity found by Fleming for electrolytic nickel. "This discrepancy is so serious that it may well be asked whether the chief conclusion arrived at by the English physicists, viz., that the resistivities of all metals converge upon the absolute zero of temperature and there become zero themselves—can be maintained. In other metals, too, there are divergencies from this supposed rule, for the resistance of platinum, silver, copper and iron would have to disappear at —258, —248.4 and —223 degs., respectively."—*Phys. Zeit.*, March 23; abstracted in Lond. *Elec.*, April 26.

Striated Electric Discharge.—Jeans.—The second part of his theoretical paper. He forms the following conception of the state of things which occur in a vacuum tube. He regards the discharge as a series of small discharges between consecutive "slabs." As the accumulation of ions which occurs in the neighborhood of a point of minimum electric force, must consist of a great number of ions which are not at rest, but are moving equally in all directions, this accumulation of ions may be more accurately described as a "nucleus" than as a "slab." There is not a sudden discontinuity of densities in the middle of such a structure. There is a rapid but continuous change. The number of ions of either kind in a nucleus is being continually increased by arrivals from adjacent nuclei, and also by the dissociation of some of the molecules which pass into it in the course of their motion. The number is at the same time decreased by the ions which are carried away from the nucleus, and also by the recombination of ions inside the nucleus. When the steady state is reached, the losses and gains arising from these four causes exactly balance.—*Phil. Mag.*, May.

Luminous Ring in Rarefied Gases.—Phillips.—A long abstract of a Royal Society paper on "The action of magnetized electrodes upon electrical discharge phenomena in rarefield gases." He discusses the conditions necessary for the production of a luminous ring in rarefied gases under the influence of electrostatic and magnetic forces. The cause of the luminous phenomena is traced to the action of the magnetic field upon electric gaseous particles within the rarefied space, and experimental evidence is given to show that the rate of charge of the magnetic lines is an important factor.—Lond. *Elec.*, April 26.

Double Refraction of Electric Waves.—Pierce.—In a former research he measured the refractive indices for electric waves of a number of doubly-refractive media, namely, various woods. These media were all also doubly-absorptive. In the present note he examines the question as to whether, on Maxwell's theory, the double absorption by these media is sufficient to account for the double refraction; and, indeed, whether both of these properties can be ascribed merely to differences of conductivity of the woods along and across the grain. He finds by analysis a means of testing experimentally such an assumption, but did not have the experimental data at hand. However, without such a test, it is still seen that heterogeneous conductivity plays an important part in the phenomenon of double refraction of electric waves.—*Phil. Mag.*, May.

Action of Radium Rays Upon Selenium.—Bloch.—Perreau has discovered that the Röntgen rays produce upon selenium an effect comparable with that of light. The present author has tested whether radium rays have a similar effect, and has found a slight effect of this kind.—*Comptes Rendus*, April 15; abstracted in Lond. *Elec.*, May 3.

Magnetic Properties of Cast Iron Containing Aluminum.—Schweitzer.—An illustrated account of tests of the magnetic properties of different sorts of cast iron containing aluminum. He found that additions of aluminum cause a decrease of the inductions for equal field intensities, and an increase of the hysteresis loss for equal inductions. The magnetic properties of cast iron therefore become worse by the addition of aluminum.—*Elek. Zeit.*, April 25.

REFERENCE.

Electric Arc.—Bermbach.—The conclusion of his article on the physical properties of the electric arc. He deals with the apparent and real phase difference in the alternating-current arc and describes briefly the acoustic phenomena in the arc.—*Elek. Anz.*, April 21.

Electro-Chemistry and Batteries.

Reducing Action of Calcium Carbide.—Von Kuegelgen.—The continuation and conclusion of his article. He deals with the reduction of copper, silver, zinc., mercury, tin, bismuth, chromium, manganese, iron, nickel, potassium, sodium, aluminum. The general result of his investigation is that calcium carbide has strongly reducing properties. The reaction is much greater in the reduction of the chlorides than of the oxides. While for the most chlorides the reaction, after it has been started once, propagates itself sometimes like an explosion, in the reduction of oxides it is nearly always necessary to heat the material, in order to keep up the reduction. A characteristic feature of the reduction of the chlorides is the easy inflammability of the mixture. The reduced metals contain only a small fraction of calcium, if in the reduction the proper quantity of calcium carbide has been used, while by using a large surplus of calcium carbide it is possible to obtain calcium alloys. In the reduction of the oxides the output depends upon the degree to which the oxide can be reduced by carbon. The more difficult it is to reduce the oxide by carbon the less will the latter take part in the reduction and the more calcium carbide is required. He calculated that for one ton of copper, 440 lbs. of carbide are required. This does not seem to be the basis for an economical industrial process. He thinks, however, that for special purposes in metallurgical plants the reducing action of the calcium carbide can be used to advantage.—*Zeit. f. Elektrochemie*, April 18, 25.

Electrolysis of Alkaline Chlorides.—Adolph.—An account of an experimental investigation of the "bell process." (This is so called because a reservoir of the form of a bell open at the lower end is suspended in the electrolytic bath, the anodes are in the bell near the top, while the cathodes are outside of the bell near its lower rim. Fresh electrolyte is continually supplied to the bell from the top.) This process is being introduced now besides the two older ones, namely, the diaphragm process and the mercury process. The experiments of the present author show that alkaline hydrate solutions can be made in much higher concentrations by the bell process, than with the same energy output by the diaphragm process, while the purity of the chlorine in both cases is about the same. His investi-

gation has been made from a scientific point of view. For industrial purposes it would be important to find not only the conditions of the best current output, but also that of the best salt concentration. Instead of the saturated solution with which he worked, more dilute solutions would be better for technical purposes. One of the most important results of his investigations is the proof that the separation of cathode solutions and anode solutions in the bell process is largely due to the free hydrochloric acid which appears in the anode space at carbon electrodes.—*Zeit. f. Elektrochemie,* May 2.

Ferro-Silicium.—GIN.—An article on the production of ferro-silicium in the electric furnace. The physical and chemical properties of ferro-silicium are discussed, the thermochemical data of its production are given and industrial methods of its production are described. He believes that this will become an important branch of electro-metallurgy, especially as many calcium carbide plants, which are now useless on account of the commercial crisis in that industry, may undertake the production of ferro-silicium to advantage.—*L'Ind. Elec.,* April 25.

Primary Cells.—PETERS.—The first parts of an article in which he gives an account of tests of several primary cells. The present installments deal with the "reform cell," the "hydra cell," and the dry cells of the Columbus Electric Company. The feature of the first two cells is the form of their zinc and carbon electrodes. They are so arranged that both electrodes have large surfaces, and that as many parts as possible of the positive electrode are opposite to as many parts of the negative electrode. For that purpose, the carbon electrodes consists of two perpendicular rods, connected together at the top. A zinc ring surrounds both carbon rods, and there is besides a zinc plate between the two carbon rods. In the hydra cell there is "besides the external zinc cylinder which is likewise contained in the reform cell, also an external one."—*Centralb. f. Accum.,* April 15, May 1.

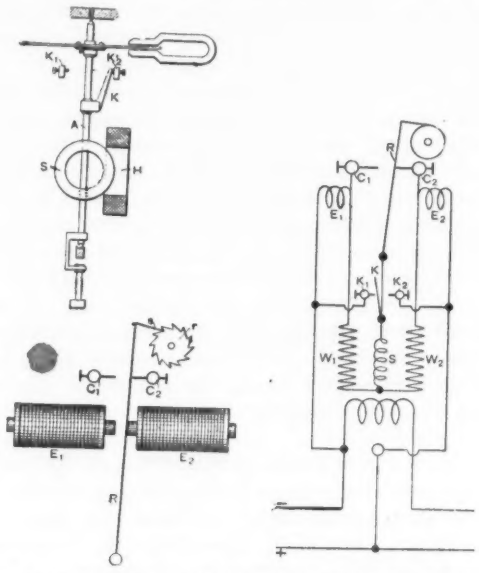
REFERENCES.

Hypo-Chlorite Cell.—J. B. C. KERSHAW.—An illustrated article on the Haas and Oettel hypo-chlorite cell, which was described before in the Digest.—Lond. *Elec.,* May 10.

Aromatic Substances.—ELBS and SILBERMANN.—An account of some experiments regarding the electro-chemical reduction of certain aromatic compounds.—*Zeit. f. Elektrochemie.,* May 2.

UNITS, MEASUREMENTS AND INSTRUMENTS.

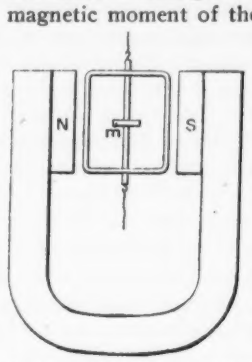
Small Direct-Current Meter.—An illustrated description of a new small meter for direct current, brought out by the Gen. Elec. Co., of Berlin. It is made up of two parts. The first, shown in diagram 1,



FIGS. 1, 2 AND 3.—SMALL DIRECT-CURRENT METER.

consists of a fixed coil *H*, through which the main current passes, and a moving shunt coil *S* on a spindle *A*. On this spindle are also fixed the braking disk and a contact arm *K*, which at two positions makes electrical connection with contacts K_1 K_2, respectively. Two fixed resistances W_1 W_2 (diagram 3), are also alternately in parallel with the shunt coil. The second part of the apparatus, shown in diagram 2, is a relay which works the clockwork, and is made up of an armature pendulum *R*, which is alternately attracted to the electro-magnets E_1 E_2, thereby making connection with contacts C_1 C_2, respectively. The action of the meter may be traced from diagram 3. In the position shown, the coil *S* and resistance W_2 are in parallel, and the direction of the current is such that the contact arm *K* is moved to K_2. This short-circuits the electromagnet E_2 and the pendulum is attracted to the magnet E_1, and makes contact with C_1. The coil *S* is now in parallel with the resistance W_1. The current, however, being reversed, the coil moves in the opposite direction, so that the arm *K* makes contact at K_1, and the magnet E_1 is short circuited, and so on. The instrument is made for currents up to 10 amperes and pressures up to 500 volts. The makers guarantee that the meter will not run on no-load, even with a pressure of 20 per cent above the normal, and it will also start at 1 per cent of the maximum. They also claim that only 1.2 watts is lost in the shunt for the 100-volt meters, and 8 watts in the main coil. A small alternating-current meter, brought out by the same company, is also described. It was described in the Digest, Feb. 16.—Lond. *Elec.,* May 10.

Measuring Instruments Having Magnets.—WEISS.—Measuring instruments in which the action of a current upon a magnet is utilized, are liable to change in their sensitiveness, owing to changes in the magnetic moment of the magnet. He compensates these changes in the following manner: In the adjoining diagram *m* is a small needle of soft iron, rigidly connected with the movable coil, and *N S* are the poles of a permanent magnet. When the latter increases in strength, the deflection is increased by the increased action upon the coil and at the same time diminished b ythe increased action upon the needle. If the needle is saturated, the deflection for the same current will be the same as before. In practice he compensates for any lack of saturation by a slight antagonistic couple in the elastic suspension. He constructs ammeters and voltmeters on this plan.—*Comptes Rendus,* April 22; abstracted in Lond. *Elec.,* May 10.



MEASURING INSTRUMENT.

Adjusting the Voltage in Laboratory Tests.—MAREK.—In the calibration and testing of voltmeters, wattmeters and meters, it is often desired to obtain a certain given voltage at the points of connection

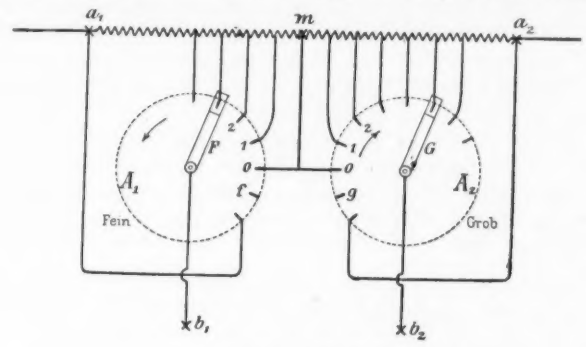


FIG. 1.—ADJUSTING VOLTAGE.

for the instruments. He describes the following method used in the Austrian Calibration Office. For direct current the arrangement

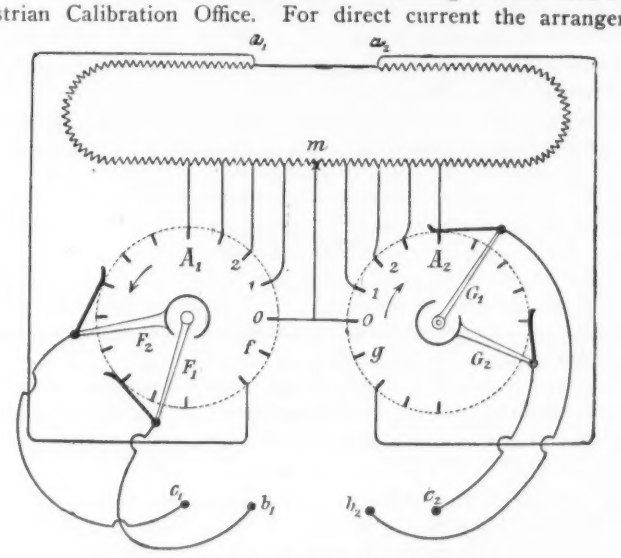


FIG. 2.—ADJUSTING VOLTAGE.

shown in Fig. 1 is used. The terminals of the supply circuit are a_1 and a_2; a_1 a_2 is a bipolar-wound manganine wire, which can stand con-

tinually about 1.1 amperes. The resistance is about 160 ohms, and is divided into two main parts, a_1 m and m a_2; m a_2 is divided into 30 equal parts, each one of which is slightly smaller than a_1 m; a_1 m is also divided into 30 parts. Each point between two parts is connected with a segment of A_1 and A_2, upon which the brushes F and G are sliding; f and g have no connections. The measuring instrument is connected between b_1 and b_2. When the switch is to be used F and G are connected to f and g. This is for determining the zero points of the instruments. G is then connected to O, and F is turned in the direction of the arrow. If the pointers of the instruments are deflected in the right direction, the connections are correct. The desired voltage may then be obtained roughly by adjusting the brush G, and accurately by the brush F. If the voltage of the supply current at a_1 a_2 is slightly more than the voltage wanted at b_1 b_2, the greatest possible error in the adjustment is 0.056 per cent. If the voltage of the supply circuit is higher than that wanted for the instruments, the same arrangement can be also used for alternating current; otherwise, the switch illustrated in Fig. 2 is used to advantage, which explains itself; c_1 and c_2 are the terminals for the supply circuit, b_1 and b_2 those for the connection of the instruments.—*Zeit. f. Elek.*, May 5.

REFERENCES.

Meter for Double Tariff.—Aron.—An illustrated description of an electric meter for double tariff. The kilowatt-hours are registered on two different dials, corresponding to the two different rates.—*Elek. Zeit.*, May 2.

Instruments of Precision.—Haerden.—The continuation and conclusion of his illustrated article. He deals with direct and alternating-current ammeters and voltmeters, measurements and capacities, construction of condensers, and compensation instruments.—*Elek. Anz.*, April 25, 28.

Iron Tests.—Moellinger.—An illustrated description of the methods used by Schuckert & Co. for commercial iron tests regarding hysteresis.—*Elek. Zeit.*, May 2.

MISCELLANEOUS.

Iron from the Electric Furnace.—A short description of a process patented by a French Company for obtaining all qualities of iron and steel directly from the ore. The furnace comprises a crucible with two vertical parallel carbon electrodes, the metal produced being drawn off through the opening below. There are two pouring holes at different elevations, the top one for slag and the lower one for metal. According to the proportion of charcoal in the mixture, and the temperature of the crucible, the different varieties of metal are obtained.—*L'Echo des Min. et Met.*, March 28; abstracted in *Min. and Metall.*, May 1.

Lightning Rods.—A set of rules, regarding the construction of lightning rods, accepted by the Electrotechnical Society of Berlin; also the report by Strecker on the work of the committee which had drafted these rules.—*Elek. Zeit.*, May 2.

Paris Exposition.—Reyval.—A long, well-illustrated description of direct-current and alternating-current machines exhibited by Schneider & Co.—*L'Eclairage Elec.*, April 13, 20, 27, May 4.

Reyval.—An illustrated article on the traveling platform.—*L'Eclairage Elec.*, May 4.

Ruhmer.—An illustrated description of the telegraph and telephone exhibits of Siemens & Halske.—*Phys. Zeit.*, April 27.

New Books.

Primi Nozioni Fondamentali di Elettrochemica.—Di Alfonso Cossa. (Hoepli Manual). Milan: Ulrico Hoepli. 113 pages, 9 illustrations. Price, 1.50 lire.

This is a small text book setting forth briefly and concisely the modern theories involved in the applications of electricity to the productions of chemical change and vice versa.

The Theory of Electrolytic Dissociation and Some of Its Applications. By Harry C. Jones. New York: The Macmillan Company. 289 pages, 9 illustrations. Price, $1.60.

The author has been frequently asked: Where can an account of the power developments in physical chemistry be obtained? And as there existed no English text-book on this subject, he wrote this as an introductory work to meet the demands of a large number of students.

After the 70 pages of the first chapter on "the earlier physical chemistry," the second chapter of 33 pages deals with "the origin of the theory of electrolytic dissociation"; in the third chapter of 67 pages the "evidence bearing upon the theory of electrolytic dissociation" is given; and the fourth and concluding chapter, of 110 pages, is on "some applications of the theory of electrolytic dissociation." He says in the introduction that his book is an attempt to answer in part the questions: What was physical chemistry before the theory of electrolytic dissociation arose? How did the theory arise? Is it true? What is its scientific use?

It must be conceded that the book is a very timely one. There is indeed a great demand for a treatise in the English language which gives a clear survey of the theory connected with the names of Van't Hoff, Arrhenius, Ostwald, Nernst, etc. It is also conceded that Dr. Jones' book is to be recommended as being one which is very easy reading; but it is to be regretted that the smoothness of the exposition of the theory is obtained somewhat at the cost of accuracy. There is often a looseness in the definitions and statements. There is also a lack of originality. The book is in many parts, especially in the fourth chapter, largely a compilation from the larger text books of Ostwald and Nernst.

It is to be pardoned when Arrhenius, Ostwald, Nernst and the other original workers in this theory, sometimes become enthusiastic and fantastic. But in a book like that of Dr. Jones we would like to have seen a little less of this enthusiasm of the originators of the theory, and a little more of the Anglo-Saxon coolness of a compiler; a little less history and a little more of a critical summary. We would like to see in the first line sharp and concise definitions of an "ion," of "electrolytic dissociation," etc. If clear definitions of these fundamental terms were given, many misunderstandings, as they still often occur, would be avoided. From a book like that of Dr. Jones, the reader also wants to get a fair knowledge of the terms commonly used in the theory. In the exposition of Hittorf's work on the relative velocity of ions (page 192 to 197) an explanation and definition of the term "transport number" should be given; a few pages later, page 202, it is said: "The unit of resistance most generally used is that of a column of pure mercury 106 cm in length, and 1 square mm in section, at 0 deg. C.; why does he not add, "and is called 1 ohm." This would not be superfluous, especially for his chemical readers, as the book is obviously intended for beginners.

In the last part of the book an unnecessary amount of mathematical calculation seems to be given. It would often have been better to have given less mathematics and more of the physical meaning of the theory. One point which we miss entirely in the book is a reference to the change of an atom into an ion. This is important, as it characterizes the relation between the ionization theory and the principle of the conservation of energy. It has sometimes been said that the dissociation theory is in disagreement with the energy principle. Such statements could, of course, only be made by a misunderstanding of the term "electrolytic dissociation," or by a difference in definition of the term dissociation. All points relating to this question have been cleared up by the theory of the energy of ionization, which therefore should find a place in a book like that of Dr. Jones.

In spite of these objections, the noticeable smoothness and easiness of reading will make the book very acceptable to many of those students who have not the time or do not care to attempt to digest the original voluminous papers.

Electric Lighting. A Practical Exposition of the Art for the use of Engineers, Students and Others Interested in the Installations or Operation of Electrical Plants. By Francis B. Crocker, E. M., Ph.D. Volume II. New York: D. Van Nostrand Company. 505 pages, 391 illustrations. Price, $3.

From the meagre book of du Moncel on "Electric Lighting" to the pretentious two-volume work of Professor Crocker covers a period of 21 years, which is practically the historical life of the subject. Following the first book referred to, came a larger book by Gordon, in which the subject was presented somewhat from an engineering standpoint, and naturally an historical summary of the advancement of the art of electric lighting may be read between the works of Gordon and Crocker. In the present books the subject has been put on an engineering and scientific basis very different from the older works, and as such it is comparable with the literature of any of the older established engineering branches. In these

books it is clearly shown that the period of tentative and empirical experimenting, and the flamboyant "patent" is about passed, and that the details of electric lighting have yielded to the approved methods of thorough engineering practice. From the standpoint of time and the perfection of the art, a work of the pretentions of the present volumes must be judged of its fitness to serve as an engineering treastise.

The first volume of the work, published some time since, was devoted to the generating apparatus and accessories, and the present volume is concerned with the distribution system and its auxiliary apparatus and devices. "Both volumes," the author states, "are intended as text books for engineering schools and as hand books for practicing engineers," and then curiously adds, "for these reasons abstruse and detailed matter has been omitted as far as possible." This latter statement is somewhat surprising to read, particularly at the present day, for, beyond students of engineering and practicing engineers, it is very doubtful if others would concern themselves over "abstruse and detailed matter." This stricture on the book would be trivial if it were not at the very root of the selection of matter for such a work, and the extent and manner of its treatment.

Advanced students of electrical engineering and practicing engineers invariably have an indifferent, and, in many cases, even a contemptuous, estimate of the formal literature of electrical engineering and applied electricity. With a few notable exceptions this estimate is only too well founded, and the reasons for it are not far to seek. Authors have been content to fill their books largely with descriptive matter and much catalogue literature. Again, many have tried to humor an unreasonable prejudice against mathematical discussion. An author with a subject such as that of Professor Crocker's comes to no easy task. Upon him devolves the labor of bringing the book up to the grade already established in mechanical and civil engineering, and causing those in these professions to respect the literature of electrical engineering, if he has any devotion to his profession. The only recourse is to present the matter with such clearness, thoroughness and detail, that it may serve as a working basis on the part of the student and the engineer.

The second volume of "Electric Lighting" shows that Professor Crocker has done this to a considerable extent, though we could wish he had been more thoroughgoing in many portions.

The first six chapters deal with the properties of electrical conductors and systems of distribution. The first chapter in particular is treated in a clear and masterly style, and leaves little to be desired. If the entire work had been written in the same spirit it would have heartily commended itself to the profession and have become an authoritative work.

Under the heading of "The Temperature Coefficient of Copper," the theory is fully and clearly stated, and its working application is discussed in a most satisfactory way. Such treatment satisfies at once the student, and leaves the engineer in no doubt in its application. It would be difficult to find a better discussion in all the literature of applied electricity. It is an excellent illustration of the maxim that the practical man is one who has a complete knowledge of the subject, as against one who simply knows a few facts.

The succeeding two chapters state the principles of alternating currents and alternating-polyphase currents. These subjects are fundamentally developed in an unusually clear and terse manner. It is a question if a great deal of this might not have been omitted to advantage, since the matter is so admirably treated in Professor Franklin's "Alternating Currents," and with more detail but much obscurity in a similar work by Professor Jackson. Where the present author is terse, however, he falls into a questionable practice. On page 129 a formula (51) is stated for the self-induction of two parallel copper lines in air. Where such a critical formula is not fully developed and discussed, a reference should be given to its complete discussion.

This instance may serve for calling attention to one of the most serious faults of the work. What a student needs above all else is to be guarded against mere formal statement and description. The practicing engineer, and the student as well, must have some knowledge of the sources where the subject he is working with is fully discussed. It is only in this manner that he can proceed with confidence and assurance in design and calculation. Judged in this spirit many portions of this work will be of no real value to its readers.

On pages 257-61 are given "General Specifications for Ordinary Pole Line Construction." It is somewhat in the nature of a surprise to find in the work of a college professor four pages of punctuated sentences which are minus the verbs. Compared with first-class specifications in general these in particular are in poor style to place before students as a model. Because one aims to be practical and terse it is no excuse for poor English; and if some practice sanctions this it is high time for the good standing of the profession that it is corrected.

One of the poorest chapters is that on meters, which is almost entirely descriptive. As a whole, the work is a commendable effort, but is disappointing. In brief, the author appears to have missed the modern engineering standpoint, and while the work will be found of value to the engineer of the day, its method would have appealed with greater force to the engineering audience of 10 or 15 years ago.

But few errors have been noticed in the matter and proof-reading. The book is well printed, but poorly bound. Another objection is that the book is too heavy for its size, doubtless from the use of paper suitable for half-tone illustration. The line illustrations are excellent in conception and printing, but the numerous half-tones are so miserably printed that they disfigure the work. Many of these are out of place in a book of this character, such as Fig. 309, page 367. They savor too greatly of catalogue literature and popular books on the wonders of electricity and lightning harnessed in the service of man.

LES PHENOMENA ELECTRIQUES ET LEURS APPLICATIONS. Etude Historique, Technique et Economique des Transformations de l'Energie Electrique. By Henry Vivarez. Paris: Georges Carre et C. Naud. 376 pages, 225 illustrations. Price 15 frs.

This book is intended for those who have not made a specialty of the subject of electricity, but who, in the course of their work, find it as necessary or desirable to obtain an insight into the subject, as it is to know something about physics and mechanics. It is therefore written in a popular and easily understood style, and begins with the first principles.

The first part is devoted to the early history, the second to the scientific period, and the third and by far the largest, to the industrial or that of the engineers, as he calls it. While this sub-division may have some advantages in a book for the layman, yet in the opinion of the reviewer it is not to be recommended, as it necessitates too much duplication, and scatters the different parts of the same subject over entirely different parts of the book. For instance, complete dynamos are illustrated and described before the general principles of their action are discussed. The descriptions are necessarily brief and perhaps not too much so for the layman, but they do not seem to be well balanced; an itemized table, for instance, of the annual production of copper from each of a number of mines, and for a long period of years, seems somewhat unnecessary and might well have been replaced by more useful information. Many other subjects which are not electrical are also discussed, some of them, like energy in general, being quite in place, but when a number of pages are devoted to the time it took nature to form coal, and to numerous tables on the amounts of coal mined in different countries and during different periods, it seems out of place in such a book.

The chapter on transmission of energy to great distances, is on telegraphy and ends with four verses of poetry. The next chapter is on telephony, but this is not considered to be a case of long distance transmission, like telegraphy. Many of the illustrations are old and have been seen before, and there is a scarcity of those showing the latest developments. There is much information of a useless kind, such as a full page table giving nothing but the voltage, horse-power and kilowatts of one dynamo of each of a large number of companies, chiefly French, leaving to the layman the impression that each of these companies makes only one dynamo of that particular voltage and power. France and French machinery are given special attention throughout the book, which is natural and quite proper for a book intended for the French people. The book concludes with a long index of proper names which are referred to in the book, a bibliographical index, and index of words and technical expressions, a table of contents, and a map of the world showing the cable lines.

The book belongs to the popular treatises of no great depth, and is not among the best of these, although it contains much that will interest those laymen who do not intend to study the subject very thoroughly or carefully, and in this respect it may serve its purpose about as well as most books of its kind.

Lightning Arresters.

By C. C. Chesney.

In considering the subject of protection from lightning from the point of view of the station manager who, as has been recently pointed out, has from year to year had occasion to give the matter more and more attention, I desire to outline certain conditions and defects and some remedies which, while novel, will be found most effective.

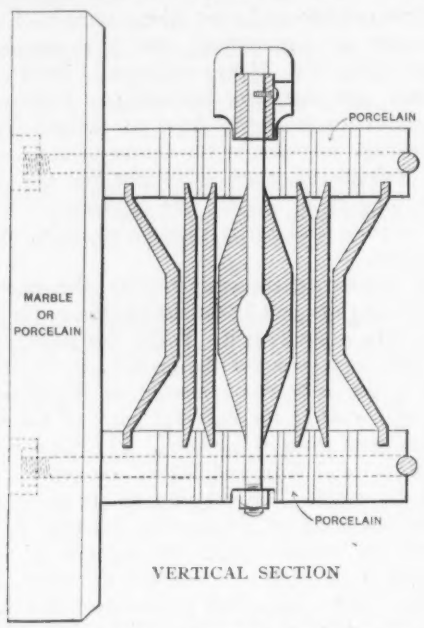
As has been pointed out, alternating-current lightning arresters, as a class, while more or less successful in protecting the insulation of the apparatus from damage or destruction by atmospheric electricity, are subject among others to the following criticisms:

First.—In some arresters the width and number of spark-gaps are so great as to require the potential of the lightning charge to be as high as or higher than a potential which would rupture the insulation of the system. In others, in order to reduce this potential the spark-gap is made so small that there is continual annoyance from grounding through the arrester.

Second.—The want of proper insulation in some lightning arresters themselves resulting in the formation of arcs over or through the defective insulation and in temporarily putting out of service one or more parts of the system.

Third.—The lack of robust character in the general design and construction, which are necessary to withstand heavy and frequent lightning discharges without total destruction.

Fourth.—The inability to break the dynamic arc quickly and without an excessive flow of dynamic current, which is apt to follow the slightest atmospheric discharge.



VERTICAL SECTION

FIG. 1.—VERTICAL SECTION OF LIGHTNING ARRESTER.

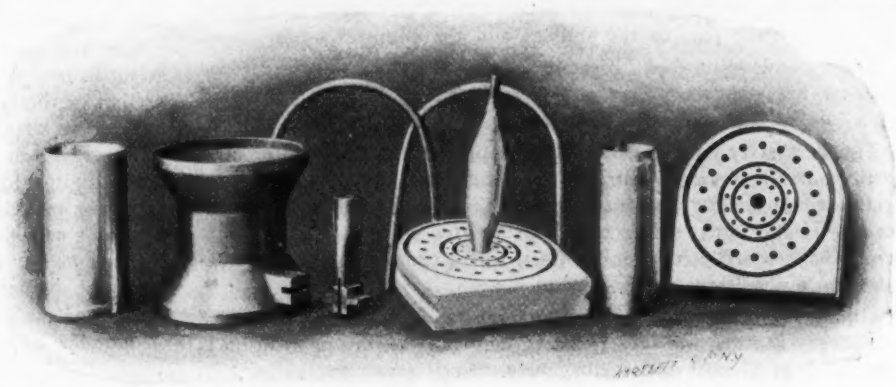


FIG. 2.—DETAILS OF ARRESTER.

Fifth.—The exposing of the line terminals, making possible the formation of arcs by the accumulation of dust, dirt, bugs, etc., and making it extra hazardous to handle the instruments on live lines when this becomes necessary.

Sixth.—Inability to handle heavy discharges, due to either lack of discharging surface or to resistance in series with the gaps, thus, by not taking all the discharge, allowing some to follow the circuit and puncture the insulation of the apparatus.

Referring to Fig. 1 an explanation will be given of the construction and principle of a lightning arrester proper, designed to appeal to those who have experienced trouble from the foregoing faults.

Two nests of concentric cylinders with diverging ends are held in relative position by porcelain caps at top and bottom, these caps in turn being securely fastened to an insulated support of marble or porcelain. To the innermost cylinder the line is connected, to the outer the earth.

Referring to Fig. 2 it will be observed that the porcelain caps are provided with grooves so placed as to make all spark-gaps 1-16 of an inch wide. Between these grooves are sufficient perforations to allow free circulation of air between the cylinders.

In the operation of the arrester the lightning enters from the line to the central cylinder, jumping the gaps in the narrower portions of the arrester and passing from the outer cylinder to the ground connection. If the dynamo current follows the lightning a current of air is at once established through the perforations of the porcelain caps and between the cylinders. This air current blows the arc upward into the spaces between the flaring ends of the cylinders, where the arc is instantly ruptured on account of the increased distance between the conical tops and on account of the increased surface of metal exposed.

Again referring to Fig. 1 it will be seen that between the line terminal and the ground connection there are three spark-gaps, each 1-16 of an inch in width, making a total of 3-16 of an inch air-gap between either line wire and the ground. At the ordinary frequencies now in vogue, 5000 volts or over are required to jump the gaps of the arrester, but at the frequency of a lightning discharge the sparking potential is reduced to less than one-half the above. This rather surprising phenomenon only shows that the relative value of spark gaps cannot be expressed by "short" and "long," and their effectiveness as lightning protection cannot be measured in inches. The importance of this feature can be best understood when it is realized that the spark-gaps of the arrester described are at least double the widths ordinarily used, yet the sparking potential at lightning frequencies is less.

It will also be noticed that the concentric cylinders provide a discharging surface many times that of most arresters. This feature is of great importance, as it enables the arrester to take care of all the heavy discharges, thereby discharging the line completely.

The standard arrester of this type is made double pole (Fig. 3), the outer cylinders being joined by a metal strip to which the ground connection is made. Thus assembled they are intended for 1000-volt circuits; for 2000 volts, two standard arresters are connected in series, the ground connection being made between the two arresters. Fig. 4 illustrates the cast iron case provided for protection from the weather in outdoor work.

In a recent editorial in the Electrical World and Engineer, the availability of reactance in continuous-current systems of sufficient quantity to fairly drive the intruding static discharge to earth, was pointed out. Further on, the difficulty encountered in alternating-current work, precluding similar procedure, was clearly indicated. But suppose we can provide a reactive coil possessing enormous opposition to the passage of lightning to be placed in the circuit between the lightning arresters and the apparatus to be protected, and which at the same time possesses practically no self-induction with alternating currents of ordinary frequency. A reactive coil possessing exactly these features and designed for exactly this service is described in a patent granted to the writer in 1898.

This reactive coil consists of parts so disposed relatively to one another that the coefficient of mutual induction is very high. It consists of two parallel coils of insulated copper strips connected in series and wound so that the current flows through them in opposite directions.

These parts are placed near together, side by side, with the result as stated, that the coefficient of mutual induction is very high and, in consequence, with ordinary alternating currents the self-induction of the two coils is nearly zero.

The fact that coils, such as above described, offer practically as great an impedance to lightning discharges as do ordinary coils, is probably due to the fact that with very high frequency discharges the phase of the current in the two parts of the coil is not the same at the same instant, and consequently because wound in opposite directions the currents exercise a reinforcing magnetic effect instead of a mutually destructive one. On the contrary, with alternating currents of the ordinary frequency, the phase is practically the same through-

out the whole length of the circuit, so that the resultant self-induction is practically zero. However this may be, the fact remains that the effective impedance of these oppositely-wound coils is very high for lightning discharges, and the self-induction is practically zero for currents of ordinary frequency. In consequence, it is possible in an alternating system to interpose a coil between the lightning arrester and the machine to be protected which will offer no practical disturbing effect either as to magnitude of the output or regulation of the system, and which will at the same time interpose an enormous opposition to the passage of lightning discharges toward the machine to be protected.

For power-transmission circuits of potentials higher than 2000 volts a number of the cylinder lightning arresters connected in series and properly associated with choke coils of the variety described, make up a lightning arrester equipment of remarkable efficiency. The correct number of arresters and choke coils for different potentials has been experimentally determined.

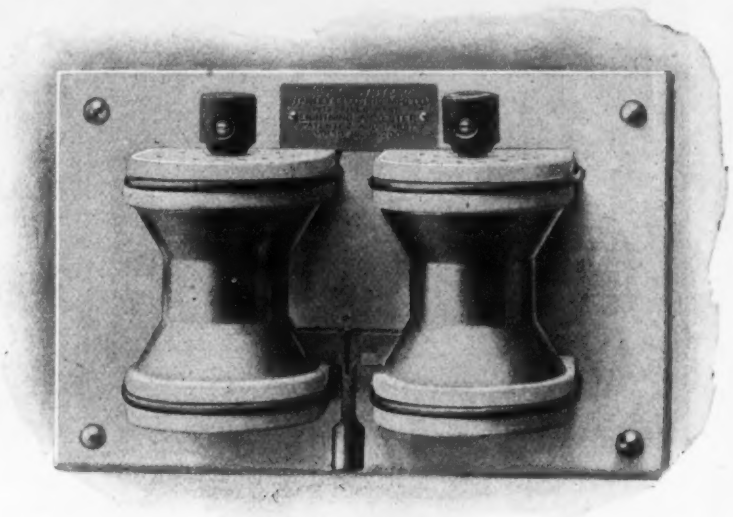


FIG. 3.—DOUBLE-POLE ARRESTER.

A large number of these lightning arresters are now in use protecting distribution circuits of ordinary potentials, and are also being used to protect power-transmission lines having a working potential as high as 45,000 volts, with entire satisfaction.

In plants where both "long" and "short" gap arresters are installed on the same circuits it will be noticed that static discharges of low potential and low frequency select as the best path of discharge the short-gap arresters, as the discharges increase in volume and frequency the large gap arresters take the discharge, leaving only a very small portion of the total to go through the short gap arresters. Therefore, neither the long nor the short gap arresters give perfect lightning protection, as the first will not take off small discharges while the second is unable to take all of the heavy discharges. The long gap arresters will give the best protection, as the small discharges might not be able to puncture the insulation of the apparatus, while the heavier discharges would surely do some damage. To remove even the slightest static discharge from the line, an instrument similar to the one illustrated in Fig. 6, called a line discharger, when used with the lightning arrester equipment above described discharges the line completely and provides, I believe, the most perfect protection from lightning yet devised.

The line discharger is a minute air-gap in series with a tube or tubes filled with oxidized metallic particles. A tube, 18 inches long, filled with such metallic particles, has practically an infinite resistance (over 50 megohms), and 2000 volts applied at the terminals would not force any appreciable current through it. The minute air-gap is placed in series with such a tube or tubes only as an extra precaution against grounding the line. The line discharger acts as a selective lightning arrester. It will not allow dynamic currents to go through, yet static discharges of extremely low potential readily pass through the tube and over the minute air-gap to the ground. In using the line discharger in connection with lightning arresters it is connected to the line between the lightning arrester equipment and the generator, as shown in Fig. 5. The number of tubes required is determined by the voltage. As the line discharger will remove even the smallest static charges, it prevents an accumulation of such charges on the line, which might prove dangerous.

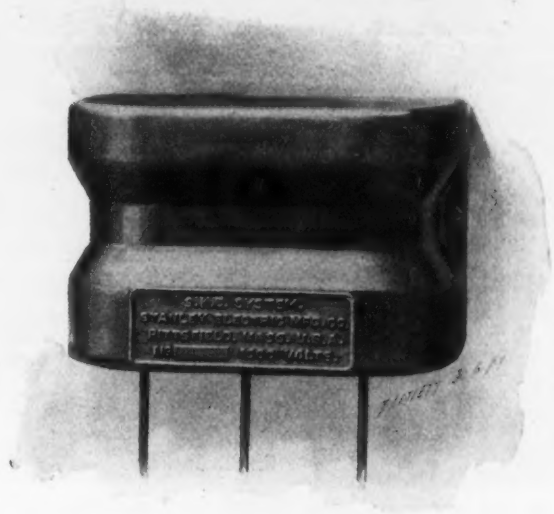


FIG. 4.—VIEW OF PROTECTING CASE.

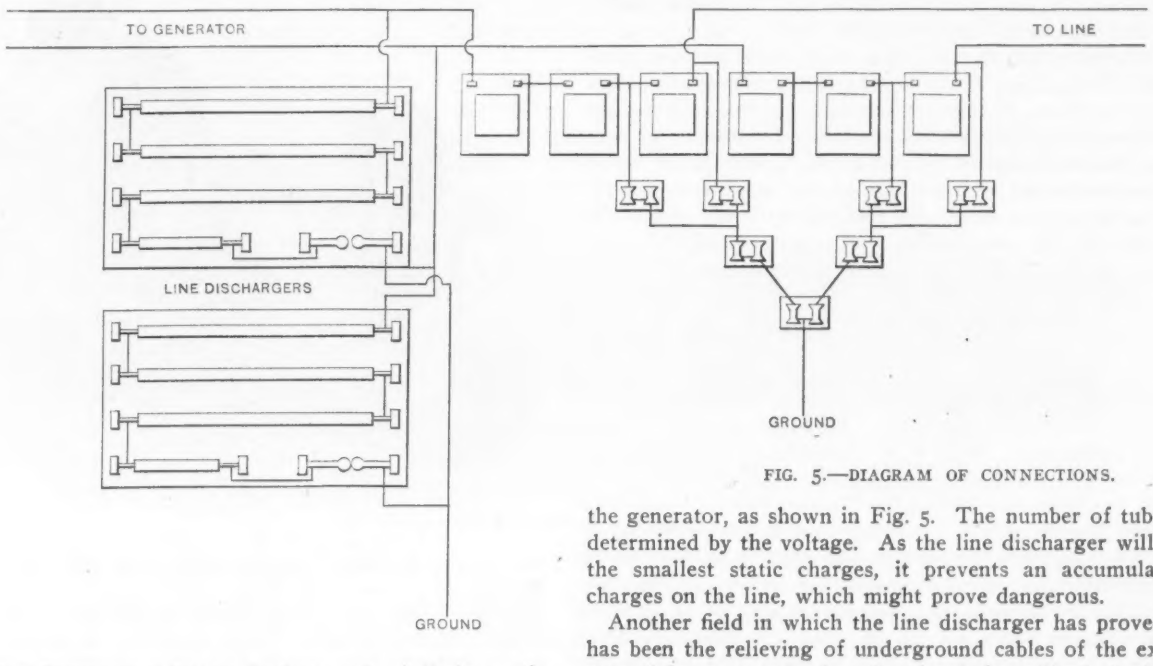


FIG. 5.—DIAGRAM OF CONNECTIONS.

Another field in which the line discharger has proved very useful has been the relieving of underground cables of the extremely high potentials generated when the circuit is suddenly broken. When a large transformer is connected to a lead-covered underground cable, and the circuit is suddenly opened, the combination of the self-induction in the transformer and capacity of the cable tends to set up very

violent oscillations in the system and the resultant potential is liable to rupture the insulation of the cable. By the use of line dischargers connecting the cable to the lead covering all danger of the oscillating current puncturing the insulation is removed. Line dischargers can

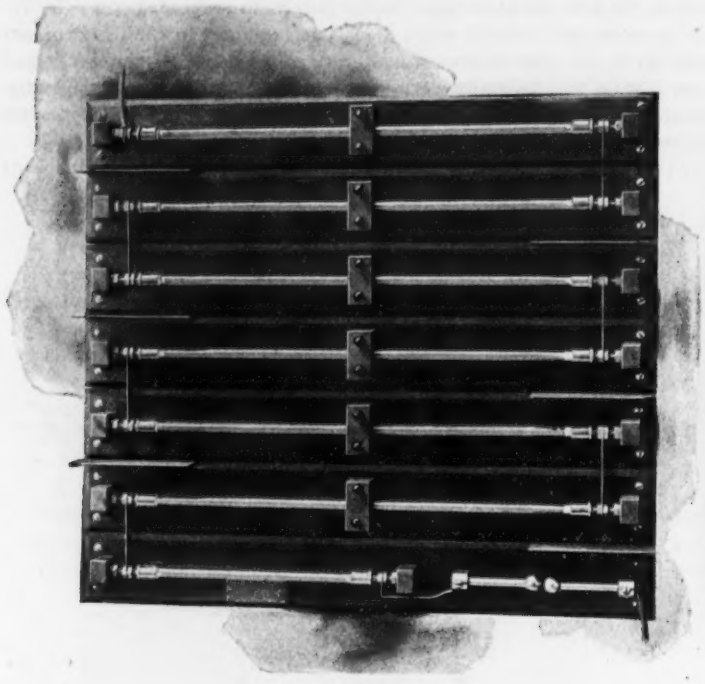


FIG. 6.—LINE DISCHARGER.

also be used to remove static charges from generators and belts. A modification of the line discharger arranged for use with direct current is particularly valuable for the protection of electric railway circuits.

Pan-American Exposition Notes.

MR. W. JAC MARLAND will have one of the most interesting exhibits in Electricity Building, comprising as it does arc lamps of various types, high and low incandescent lamps, telephones connected up through the switchboard in the booth, electric headlights, portable drills, medical batteries, trolley equipments, carbons, annunciators, portable electric lamps, telesemes, everything in the exhibit being kept "alive." Practical demonstrations will be made such as will attract the attention of the vistors who "want to see wheels go round," just as much as Budge and Toddie ever did.

THE E. G. BERNARD COMPANY, of Troy, N. Y., will occupy a small building at the western edge of the north basin in the southwestern part of the Pan-American Exposition grounds. In this building the company will have offices and two 100-kw motor generators for supplying the big electric fountain in the middle of the north basin. These motor generators are for transforming the 500-volt current received from the power circuit of the Exposition service plant into 110-volt current for the searchlights. The motor-generators and switchboard are furnished free by the E. G. Bernard Company as an exhibit, and will make a very satisfactory and distinctive display for that company.

Pan-American Automobile Mail Service.

Through the courtesy of Mr. D. W. Sowers, superintendent of the Buffalo branch of the New York Electric Vehicle Transportation Company, we illustrate herewith the Electric Vehicle Company's automobile mail wagon, which is employed by the Government to transport the mails between the general post office in Buffalo to the Pan-American post office and to the mail car located at the Pan-American grounds. This vehicle is making an average of 40 to 45 miles per day. The vehicle is one of the parent company's standard delivery wagons. They are using at the present time two of the standard chloride batteries, changing the batteries every two trips. This is, however, oftener than necessary, but it is done to insure a perfect service and for the good of the life of the battery, as the total discharge of the battery is not approached.

The vehicle has been running about three weeks, and has had but one mishap, which was the stripping of a pinion, probably caused by the great amount of mud and slush which the vehicle had to pass through in making the tour of the grounds, which at that time were not in a completed state. The vehicle has carried as great a load as 1400 lbs., but the average load is about 900 lbs.

The schedule of the trips made shows that the vehicle is running on a 30-minute headway, which includes a mile through the crowded Pan-American grounds. Taking this into consideration the time

AUTOMOBILE MAIL WAGON.

made is remarkable in view of the fact that the vehicle is on duty from 6.15 a. m. until 10.15 p. m. Bridges are crossed with a grade of from 15 to 20 per cent.

Single-Phase Motors for Pumping.

The accompanying illustrations show two electrical pumping arrangements to which single-phase alternating-current motors have been applied by the Wagner Electric Manufacturing Company, of St. Louis, Mo.

Fig. 2 shows a slow-speed single-phase alternating-current motor geared to a triplex pump, and Fig. 1 a centrifugal house pump driven by the same type of motor. This latter arrangement is a particularly neat and serviceable outfit for this class of work, as

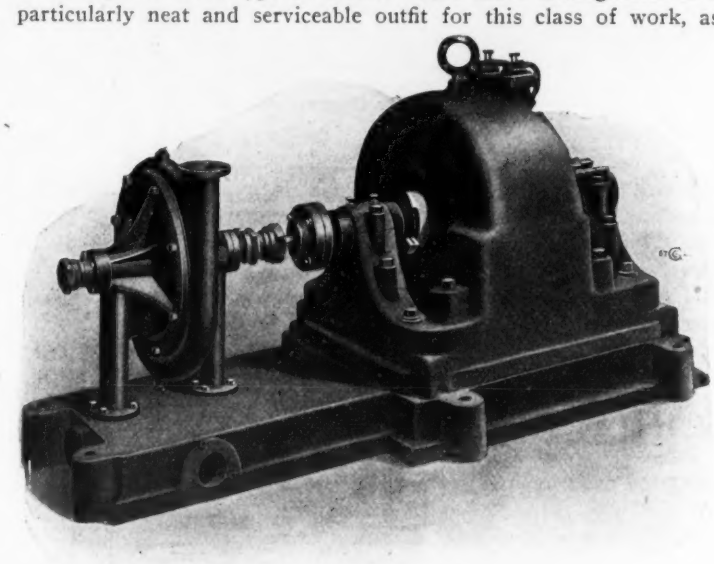


FIG. 1.—ELECTRICALLY-DRIVEN CENTRIFUGAL PUMP.

the pumps have no valves, pistons or sliding surfaces of any kind, except one stuffing box, and are practically noiseless. Among pumping plants recently supplied by this company with single-phase motors is one for city pumping, installed at Whitehall, Ill. The motor drives a pump having a capacity of 15,000 gallons per hour, and is controlled entirely from the power house, situated about one mile from the pumping station. The water is pumped through 6000

ft. of pipe line against a head of 156 ft. into a reservoir at the top of the water tower. The pump is started after the heavy part of the

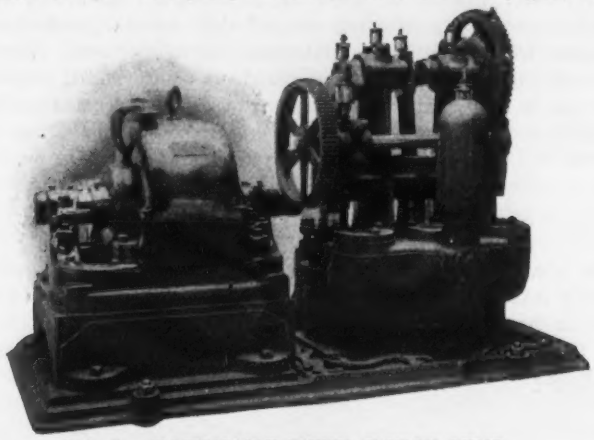


FIG. 2.—ELECTRICALLY-DRIVEN TRIPLEX PUMP.

commercial lighting load goes off at night, and is operated until morning by the generator which supplies the lighting load.

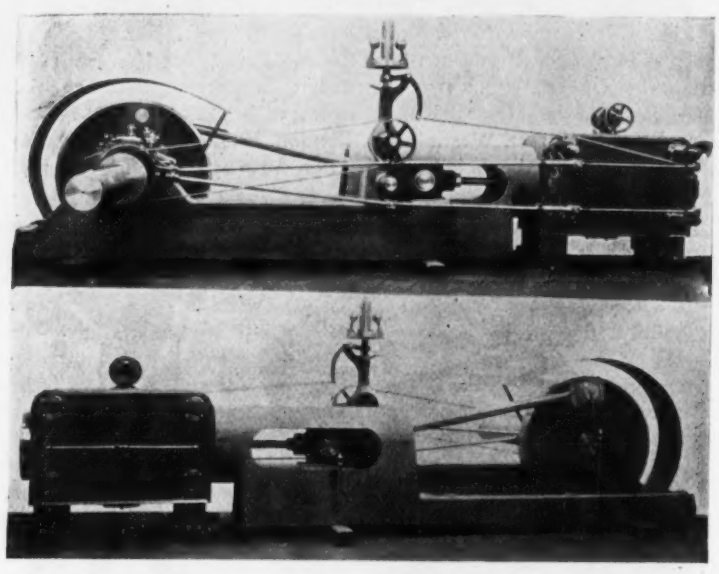
"Twentieth Century" Engines.

The Lane & Bodley Company, of Cincinnati, Ohio, has on exhibition, at the Pan-American at Buffalo, the first of a line of twentieth century engines. The loss of its patterns by fire recently made it necessary to complete a new line of Corliss engine patterns. It took this opportunity to design an engine embodying all of the improvements which its 50 years in the steam engine business showed it to be of value. The requirements which it has designed the engine to fill are that it shall stand 150 lbs. steam pressure, that the ports shall have ample area for a piston speed of 750 ft. per minute and that in case of necessity, the valve gear and other parts of the engine shall work quietly and easily at 125 r. p. m. It does not recommend this speed, but appreciate that there are conditions under which it is desirable.

The engine is of pleasing outline, all ribs and sharp corners having been omitted. The frame is of the heavy duty type, having a bearing on the foundation for the full length and width. The guides are bored to a large radius; the main bearing is made in four sections, wedges being forced downward from the top to permit of the removal of the quarter boxes after removing the cap. The bottom shell can be removed by revolving on the shaft, after raising the shaft less than half an inch, thus making it a very easy operation to inspect this important detail of the engine, and obviating the necessity of removing the eccentrics or governor pulley, to withdraw the wedges from the side.

All oil drips from the guides, cross-head, main bearing, crank pin and eccentrics are collected and carried into a cast iron drip pan under the crank, whence they can be drained and filtered, if desired. The outer bearing is of the floor-stand type, and the bearing proper is made in four sections, the same as the main bearing. The cross-head shoes are removable without disconnecting the connecting rod, which is of the usual solid end type, with babbitted crank pin boxes, and bronze cross-head pin boxes. The cylinder has round corners, with sheet steel lagging and polished angle corners. In the valve gear a most striking innovation has been made. The steam and exhaust valves are each operated by a separate eccentric, the eccentric rods connecting to rocker arms, and from there two parallel rods are attached directly to the steam and exhaust bell cranks. These rods are all light, and the travel being only 3½ inches, the vibration and jar due to excessive inertia strains commonly noted in ordinary Corliss valve gear at high speeds, are entirely obviated. The valves are double ported and of small diameter. The steam lever which operates the steam valve is keyed to the valve stem between the front of the bonnet and the stuffing box, thus supporting it on both sides of the point where the work is applied, and reducing to a minimum the chance of a broken valve stem.

The dash pots are of an improved type of vacuum pot, consisting of a single cylinder and plunger. The rod is attached to the latter by a ball joint, and the location of the dash pots, close up under the steam bonnets, makes the rods short and light, places the dash pots in a convenient place for inspection and adjustment, and removes them from the dust and dirt by which they are usually surrounded when placed on the floor. The lubrication of the plunger is effected by applying oil to the plunger in a groove at the top of the cylinder. The tendency of the vacuum is to draw the oil into the cylinder instead of its being blown out by the air of the compression chamber, as was the case with the old type. The governor is of the company's well-known Hartnell type, running 200 r. p .m., making it very sensitive to slight variations in load.

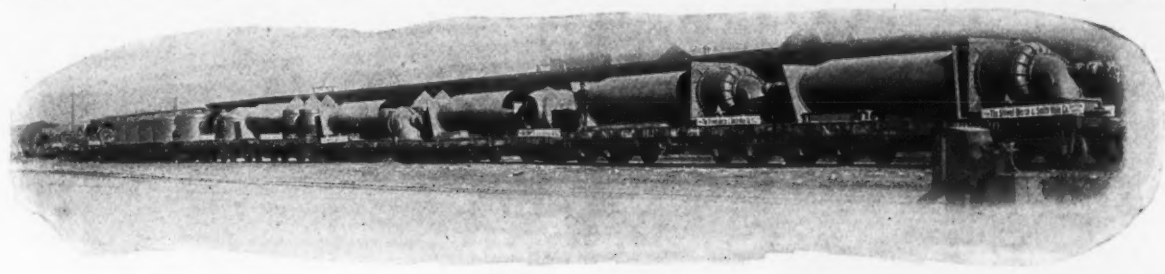


TWENTIETH CENTURY ENGINE.

A Large Shipment of Turbines.

The accompanying cut illustrates a shipment recently made to the Remington-Martin Company, of Watertown, N. Y., by the Stillwell-Bierce & Smith-Vaile Company, of Dayton, Ohio. The train consisted of nine carloads of Victor turbines and appurtenances, there being five 39-inch, one 24-inch, two 21-inch machines, and one 18-inch improved cylinder gate Victor turbine, with penstocks, draft tubes, etc.

Each wheel is mounted singly upon a horizontal shaft, and encased in a steel penstock with a heavily ribbed cast-iron head, this head being rounded so as to give the best possible appliance of the water to the wheel. To this head will bolt the cast-iron quarter-turn through which the wheel will discharge into a draft tube about 22 ft. long. On the neck of each quarter turn is provided a self-oiling ring thrust bearing for taking care of the end thrust of the wheel, and outside of this bearing the shaft is fitted with a pair of heavy face couplings for direct connecting with the pulp grinders and electrical machinery. The total power developed by the wheels will be 4375 horse-power under 42 ft. working head of water.



TRAIN LOAD OF TURBINES.

These wheels will be installed in a new pulp and paper mill at Norfolk, N. Y., which is being built by the Remington-Martin Company, of Watertown, N. Y. The water is conveyed from the Raquette

River through a wooden penstock and discharges into an open flume from which the turbines will receive their supply. The wheels will be mounted on concrete arches, with the draft tubes reaching through to the tail water below. The whole, when completed, will make a very compact and model plant.

Wheatstone Bridge and Illumination Photometer of English Make.

Electrical instruments of English design and manufacture always possess more or less interest to American electrical engineers and the trade in general. The two instruments illustrated herewith are manufactured by Messrs. Nalder Brothers & Co., Princess Mews, Great George Street, Westminster, London, England.

The instrument shown in Fig. 1. is a new form of Wheatstone bridge,

FIG. 1.—WHEATSTONE BRIDGE.

FIG. 2.—PHOTOMETER.

which, it is stated, retains all the advantages of the old post office pattern and possesses improvements in other points. The plugs are placed wider apart than in the old form, so that they are more easily manipulated, and the size of the blocks are increased, thus diminishing the block error. A new and improved form of coil is used, which reduces the depth of the box. The units, tens, hundreds and thousands are arranged in four separate bars, which are joined underneath so as to give a clear way through between each two. Another advantage claimed for this bridge is the extra pair of ratios, namely, 1, 10, 100 and 1000, instead of 10, 100 and 1000, thus increasing the range of the instrument tenfold each way.

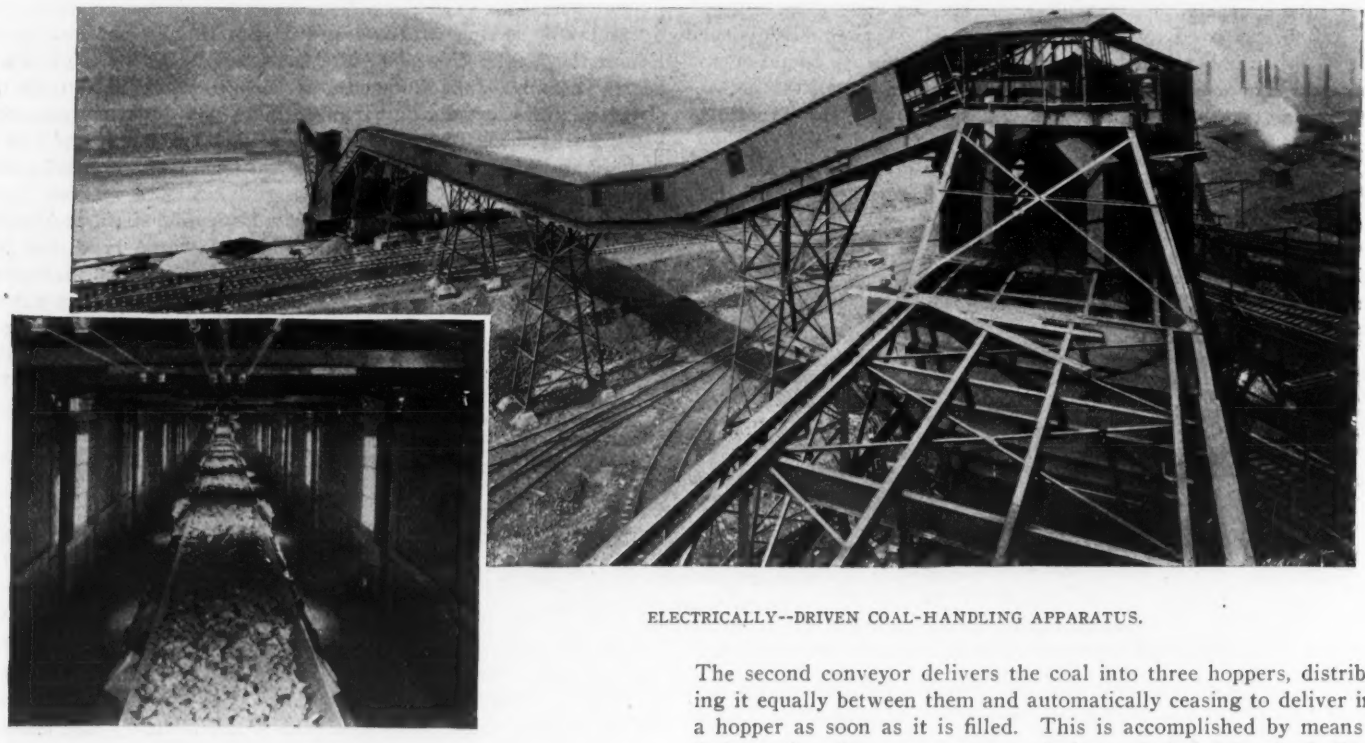
Fig. 2 represents the Preece-Trotter Illumination Photometer of new pattern. Instead of using an incandescent lamp and battery as in former designs, it works with an amyl-acetate standard, which is claimed to be much more reliable and less troublesome. The flame is not affected by a gentle breeze, and on windy nights the instrument can be easily shielded by a piece of cardboard or other similar protection.

A Motor-Driven Coal Handler.

The accompanying illustration shows the coal-handling apparatus recently installed by the Robins Conveying Belt Company, of New York, at the works of Jones & Laughlins, Limited, Pittsburg, to carry coal from the river front to the coke ovens. The amount of coal conveyed daily varies from 2500 to 3000 tons, and as the elevator and conveyor can easily handle 500 tons per hour the daily consumption of the thousand coke ovens dependent on the system can be cared for in a single shift, including the time lost in shifting boats and other similar delays. The enormous quantity of coal handled daily is said to bring the expense to the minimum.

The elevator consists of a double row of steel buckets, each measuring approximately 4 ft. long by 2 ft. wide and 2 ft. deep, and these buckets, 70 in number, are attached to a steel chain. The elevator is supported at its head and foot on a boom which is moved in an inclined plane by an electric motor, and in this way its position can be adjusted to any stage of water. Another motor drives the chain, and a third warps the coal barges into position and moves them along under the elevator as fast as the coal is removed. Through these three motors one man operates the entire system, controlling the working of the elevator and shifting the boats with perfect ease. This elevator was designed by Jones & Laughlins, Limited, and built at their works.

At the head end of the elevator, the coal is delivered to a Robins conveyor of the 30-inch size. As shown in the illustration, the conveyor first runs at a somewhat steep incline, the grade being 20 degs. After reaching a sufficient height, the conveyor runs horizontally, crossing several railway tracks, including the main line of the Baltimore & Ohio Railroad, over which it passes at a height of 24 ft. Near its inshore end it takes an upward curve and on reaching a height of 68 ft. delivers its load to another similar conveyor running nearly at right angles to the first. This conveyor is 250 ft. between centers.

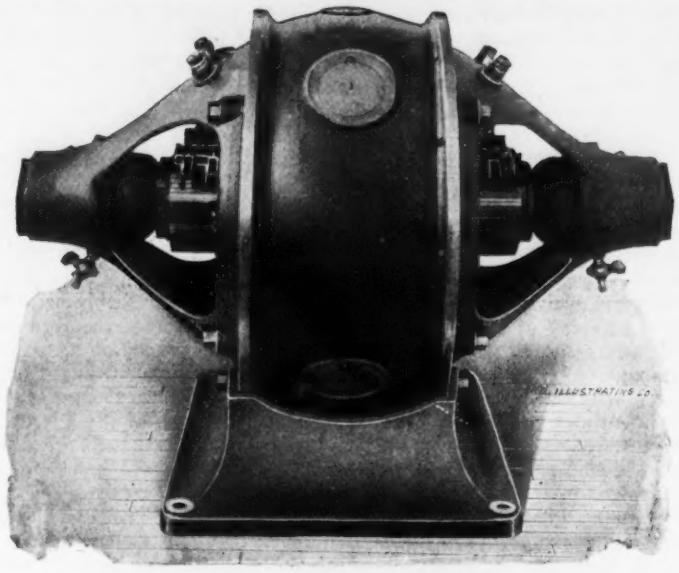


ELECTRICALLY--DRIVEN COAL-HANDLING APPARATUS.

The second conveyor delivers the coal into three hoppers, distributing it equally between them and automatically ceasing to deliver into a hopper as soon as it is filled. This is accomplished by means of "trippers," and an arrangement of chutes designed by the builders. Both conveyors are driven at the end where they receive the load, and not at their head ends, as one would expect. By this arrangement the motor of the long conveyor is located in the house, which also contains the elevator motors, and this concentration of the power plant is of undoubted convenience.

A New Double Commutator Dynamo.

The accompanying cut illustrates a double-commutator machine, built by the Jenney Electric Manufacturing Company, of Indianapolis, Ind. The machine is an equalizer for a three-wire system of distribution in a large printing establishment, where only a 500-volt current was available for driving the presses and other machinery. On account of supposed danger from 500-volt motors, the three-wire system was adopted for motor service, the motors being wound



DOUBLE COMMUTATOR DYNAMO.

for 250 volts. The equalizer maintains the same voltage on each side of the neutral wire.

This company builds double commutator machines for other purposes, such as motor generators to transform direct currents from one pressure to another, and also for motor service, where a large variation of speed is desired. These machines for small and moderate capacities are made of the "Universal" motor type, as shown, and the larger capacities are built on the open generator form of frame.

Rapid Workshop Building.

An excellent example of American enterprise was recently afforded at the works of the B. F. Sturtevant Company, Jamaica Plain, Mass. Early on the morning of Sunday, April 14, fire was discovered on the

FIG. I.—RUINS AFTER THE FIRE.

third floor of the electrical department in the extensive Sturtevant works. Before effective resistance could be presented the flames had spread through the entire engine and electrical departments. They lapped over the intervening spaces, burned off the roof of the engine storage building and worked down through two floors of the office building. But the fire wall around the power plant held them at bay and the fire was eventually confined to the building in which it originated. Some idea of the effects of the fire can be gained from the accompanying illustration.

New office and drafting-room quarters were immediately secured in a nearby building, and by Monday noon work was progressing much as usual. The patterns were in a building not reached by the fire. Although the fire had destroyed over an acre of floor space the great extent of the works made it possible by a process of change and compression to provide available space in the remaining three acres of floor area. This was done with the utmost dispatch. A large

FIG. 2.—THE NEW ELECTRICAL DEPARTMENT.

shipping and storage area on the main floor was immediately transformed into a machine shop for heavy work, the large galvanized iron department gave way to a tool room and machine shop for lighter work, while the electrical department was installed on the vacated floors of another building. The introduction of electric motors at local points simplified the matter of power transmission. Thirty days after the fire these shops were thoroughly established, as evidenced by the accompanying reproduction of a photograph taken on May 14, work was going on as of old and orders for engine and electrical equipments were receiving prompt attention. The two weeks necessarily required for the adjustment of insurance delayed by that amount effective work upon the ruins, but no sooner was the matter settled than order began to appear out of chaos.

Artistic Showroom Arrangement.

The illustration herewith in addition to being a very excellent picture, represents the "talking machine parlors" of the Western Electric Company's Philadelphia branch, being located on the eighth floor of its new building, 931-933 Market Street. The main parlor is a sumptuously furnished apartment 40 by 60 ft., and is a model of beauty and comfort, being fitted up with hardwood floors, Turkish rugs, ferns, etc. In the centre of the room, as in the illustration, is a gold-plated concert phonograph, which is the personal property of Mr. Thomas A. Edison, the inventor. This machine was on exhibition at the Paris Exposition. Having the talking machine parlor

PHONOGRAPH PARLOR.

on the eighth floor of the building has the advantage of getting away from the din of the street, and enables visitors to hear the phonograms in a room with perfect acoustics and with no disturbing noises. It has been ararnged to give a series of concerts every Wednesday afternoon, and the room has been fitted up with sockets which run along near the floor so that the electric phonographs may be arranged with direct connection on one side of the room, while the audience is seated at a proper distance away. There is an excellent suggestion here for other supply houses.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 3, and sixty day loans at 4. In the stock market transactions fell off very decidedly during the week, the public interest being on a limited scale. Liquidation, as a result of the disturbance of three weeks ago, is apparently completed, and large financial interests seem to now give support to their specialties. Manipulation and professional trading, in fact, seem to have supplied the larger part of last week's activity. The traction and electric stocks have, in common with the principal railway securities, relapsed to normal conditions, and no noteworthy features made themselves apparent during the week. Brooklyn Rapid Transit exhibited some weakness, closing with a net loss of 1⅜ points on sales of 39,805 shares. The price fluctuated between 74⅞ and 77, closing at 75⅝. Metropolitan Street Railway closed with a net gain of 1¼ points, the closing figure being 169¼. The highest price reached was 170½ and the lowest 165, the sales aggregating 43,400. General Electric maintained a steady tone, closing at the same quotation as that of the week before last, 223. There was limited trading in this stock, the number of shares sold being 3700. Western Union was weak, losing 1⅜ points net on the week's business. In the outside market the week showed an insignificant volume of sales. Following are the closing quotations:

NEW YORK.

	May 18.	May 25.		May 18.	May 25.
General Electric	223	223	Electric Vehicle	11	11½
Brooklyn Rapid Transit	77	75⅝	Electric Vehicle, pfd	16	18
Metropolitan Street Ry	168	169¼	General Carriage	2	2
American Tel. & Cable	98	99¼	Illinois Elec. Veh. Tran.	⅞	⅞
Western Union Tel.	93⅜	92	Hudson River Tel.	120	120
American Dist. Tel.	—	—	N. E. Elec. Veh. Tran.	3½	3
Commercial Cable	—	—	N. Y. Elec. Veh. Tran.	1⅜	1⅜
Electric Boat	14	15	Tel. & Tel. Co. of Am.	5	5
Electric Boat, pfd	40	40	N. Y. & N. J. Tel.	167	169
Electric Lead Reduc'n	2½	3½			

BOSTON.

	May 18.	May 25.		May 18.	May 25.
New England Telephone	—	—	Erie Telephone	*60	58
Mexican Telephone	2⅝	2½	General Electric, pfd	—	—
Westinghouse Electric	—	63	Am. Tel. & Tel.	174	180
Westinghouse Elec., pfd	—	—	Boston Electric Light	*240	*240

PHILADELPHIA.

	May 18.	May 25.		May 18.	May 25.
Electric Storage Battery	66	63	Philadelphia Electric	6	5⅞
Elec. Storage Batt'y, pfd.	65	60	Pa. Electric Vehicle	1¼	1¼
Elec. Co. of America	9⅝	9	Pa. Elec. Veh. pfd.	1	1
General Electric Auto	—	—	Am. Railways	48¾	45¾

CHICAGO.

	May 18.	May 25.		May 18.	May 25.
Chicago Edison	173	*175	Chicago Telep. Co.	260	260
Chicago City Ry	250	255	Union Traction	14¾	16½
National Carbon	15⅜	15⅞	Union Traction, pfd	57	57½
National Carbon, pfd	82	83	Northwest Elev. com.	43	49½

*Asked.

AN EXTENSIVE CONSOLIDATION.—The terms upon which the shares of the Electric Company of America and the shares of the Railways Company, which between them own a large number of central station and trolley properties, are to be purchased have been agreed upon and are stated officially as follows: A new company is to be formed with the following capitalization and bonded indebtedness:

Common stock, 100,000 shares at $50 each	$5,000,000
Preferred stock, 50,000 shares at $50 each	2,500,000
Bonds, 4 per cent	15,000,000

The preferred stock is to be entitled to dividends up to 5 per cent., but the dividends are not to be cumulative. It may be retired at par, and it may subsequently be changed for common stock. Of the $15,000,000 bonds to be issued, $3,500,000 are to remain in the treasury to be sold for cash or used in the acquirement of other properties. $2,500,000 of the bonds, with a stock bonus, are to be sold at par for cash, the stockholders of each of the companies being entitled to subscribe. The issue of $2,500,000 bonds to be sold for cash has been underwritten by Messrs. Ervin & Company, the bankers. It has been agreed that $55 per share shall be paid for the stock of the American Railways Company in 4 per cent bonds, with a bonus of 35 per cent, or $19.25 in the common stock of the new company; and that $11.50 per share shall be paid for the stock of the Electric Company of America in 4 per cent bonds, with a bonus of 35 per cent or $4.025 in the common stock of the new company. The shareholders in each of the existing companies will have the privilege of subscribing to the 4 per cent bonds to be issued for cash to the extent of 20 per cent of the amount of bonds to which they will be entitled for their shares in the respective companies. Subscribers to these bonds will receive for each $1,000 in cash: 4 per cent bonds $1,000; preferred stock $900 and common stock $500.

ERIE TELEPHONE.—The next regular meeting of the directors of the Erie Telephone Company will be held in Boston on Tuesday, June 25. At this meeting the reports of Stone & Webster and the Eastern Audit Company, will be officially presented to the board. These reports, with a statement of the earnings for the five months ending May 31 of this year, may be taken as a basis upon which a plan for permanently financing the company can be founded. Many of the stockholders anticipate the paying of semi-annual dividends at the rate of 4 per cent per annum, the first dividend of 2 per cent to be paid in July. The gross earnings for the three months ending March 31 will exceed the same period last year by $300,000 and a larger percentage of increase can be maintained throughout the year. The permanent plan of financing the company will probably provide for the raising of $15,000,000 of money to be called in as required for extensions and to pay the temporary loan of $7,500,000 at maturity, Jan. 10, 1902, thereby dissolving the trust. A dispatch from Boston states that one of the results of the visit of Philip Dexter, vice-president and chairman of the Executive Committee of the board of directors of the Erie Telephone Company, to the West, will probably be a much more vigorous policy in dealing with the independent companies in that section, where low rates and heavy expenses have prevailed. The new policy with regard to this company will undoubtedly be to raise the rates wherever the Erie Company has a strong foothold, and endeavor to retain subscribers by superior local and long-distance service. The party line system will be extended in this section.

NEW YORK GAS & ELECTRIC LIGHT.—There was filed with the Secretary of State certificate of agreement for the consolidation of the New York Gas & Electric Light, Heat & Power Company and the Edison Electric Illuminating Company of New York, forming the New York Edison Company, to operate in the counties of New York, Kings, Queens, Richmond and Westchester. The Power Company has a capital of $36,000,000 and the Edison Company $9,200,000. The capital of the new company is $45,200,000. The stock of consolidating companies, except 89,265 shares of the stock of the Edison Company held in trust, are to be convertible into stock of the new company on the basis of 1.251 shares of new stock for one share of Power Company stock, and five shares of new stock for one share of Edison Company stock. The directors of the new corporation are Anthony N. Brady, Harrison E. Gawtry, Stephen S. Palmer, Thomas E. Murray, Samuel E. Beardslee, Nicholas F. Brady and Louis B. Gawtry. Mr. A. N. Brady is president.

NEW AMERICAN TELEPHONE STOCK.—A Boston despatch states that the directors of the American Telephone & Telegraph Company expect shortly to offer $22,000,000 of new stock at par to the stockholders on the basis of one share of new stock for three shares of old. This offer is dependent upon the authorization of an increase of capital stock by the stockholders at the meeting in June from $100,000,000 to $150,000,000. At present there is $62,000,000 of stock outstanding.

DIVIDENDS.—The Chicago City Railway Company has declared the regular quarterly dividend of 3 per cent., payable June 29. The National Tube Company has declared the regular dividend of 1¾ per cent on its preferred stock, payable July 1. The American District Telegraph Company of Brooklyn has declared a semi-annual dividend of 3½ per cent, payable June 10.

PHILADELPHIA BELL TELEPHONE.—The Philadelphia Bell Telephone Company stockholders have approved the increase in capital stock from $6,000,000 to $8,000,000. $1,000,000 new stock will be issued at once. Stockholders of record to-day having the right to subscribe to 16⅔ per cent of present holdings at par until June 18.

CHICAGO LIGHTING COMBINATION DENIED.—La Salle Street has the story again that the Chicago Edison Company is to be absorbed by the People's Gas Company. President Insull, of the former Company, declares there is no truth in the report and that it is not probable that any merger of the two companies will be effected just at present.

NEW YORK SUBWAY CAPITAL.—The Empire City Subway Company (Limited) of New York City has filed with the Secretary of State a certificate of increase of its capital stock from $1,750,000 to $2,250,000. The certificate was signed by J. W. Lieb, Jr., and John H. Cahil.

Commercial Intelligence.

THE WEEK IN TRADE.—The general situation, as indicated by reports to the mercantile agencies, is largely a favorable one, the primary encouraging feature being the fine outlook for the country's crops. Industrial conditions head the list of disturbing features, but confidence in conservatism and good counsel is widespread, and the effect on general business of the idleness of the large number of men from strikes is apparently minimized. A few railroads show a decrease in earnings as compared with last year's highly favorable returns, but the majority reflect, in progressive gains, the enormous current business of the country. The building trades, except in places affected by strikes, are busily employed, and all materials find ready sale. "All in all," says *Bradstreet's*, "the situation, therefore, may be classed as one of much encouragement, with prospects for legitimate business generally equal to, and in some respects, superior to anything in the past." In the iron and steel trade, the demand for finished products is as heavy as ever, structural materials, bars and plates being in especially good demand, with premiums paid for quick delivery, and a large new business not accepted because of the inability of manufacturers to promise immediate shipments. The strike among machinists for higher wages and a shorter day has been a very general one. It is reported that 40,000 men have been granted their demands and that 30,000 more are unfortunately still idle. Strikes in the building trades in New York City and in other places will, it is estimated, swell the number of idle men to 60,000. The failures for the week, as reported by *Bradstreet's*, aggregated 192, which was the same as those of the week previous. For the corresponding week last year the number was 167. There was no change in copper. The leading producers are still holding to their figures of 17c. for spot and 16⅝c. for electrolytic.

MACHINIST STRIKES.—For the past two weeks there has been much disturbance in labor circles throughout the East and Middle West by strikes and rumors of strikes among machinists and workmen in the metal trades. Many electrical and kindred industries were involved. In some cases the demands of the strikers have been acceded to and in others the men are still holding out. The Cincinnati Milling Machine Company granted the nine-hour day asked for. At the Watsessing works of the Sprague Electric Company fifty machinists, winders, and others struck on May 23 for ten hours' pay for nine hours' work. Among the strikers were twenty young women. The Stillwell-Bierce and Smith-Vaile Company at Dayton started its works on May 21 with non-union men. The Crocker-Wheeler Company's machinists gave trouble and the company last week closed the works and notified the workmen to remove their tools at once and receive the pay due them. Reports of strikes have come from Dunkirk, N. Y., Boston, New London, Conn., Indianapolis, Ind., Baltimore, Cleveland, Cincinnati, Buffalo, Scranton, Pa., and many other places. The General Incandescent Arc Light Company, of New York, writes us: "On May 22, the company as manufacturers of arc lamps, switches, switchboards, power motors, flush switches, etc., arranged with their employees to run their factory fifty-four hours per week, and pay the same wages as were paid when the factory was running on a sixty-hour basis." Matters are improving this week.

THE NATURAL FOOD COMPANY STRING WIRES.—Among the many important additions to the already long list of noted factories at Niagara Falls, N. Y., is that of the Natural Food Company, commonly known there as "The Perky Plant." This company has contracted for 2500 electrical horse-power from the Niagara Falls Power Company. The work of stringing the cables was begun May 15. From the power-house feeder switch cables will be run to marble panels, having the well known General Electric time element relay and circuit breakers. From the panels to the exterior of the power-house, there are four cables of 500,000 c. m. each. From this place, 2 two-phase lines in parallel are strung on poles to the canal of the Hydraulic and Manufacturing Company, where the 350,000 cm cables will be increased to 750,000-cm lead sheathed and continued the rest of the distance underground. The plant of the Natural Food Company is located near the Falls, and in sight of the upper rapids. There will be a grand opening of the plant in June. It was the desire of the company to have completed the plant ere this, but since Mr. Perky promised several months ago to make shredded wheat biscuit in his place by May 15 he secured the necessary apparatus and gave a public demonstration of the processes. Electric heating will be freely used in connection with the Perky plant.

THE ROWLAND TELEGRAPH.—It is stated from Baltimore that the heirs of Prof. Henry Rowland, of Johns Hopkins University and business men in Baltimore who organized the Rowland Company are deeply interested in the reported success of the Rowland multiplex telegraph printing invention in Germany. The Baltimore Company owns the invention. Louis De Goll is president, F. H. Hambleton, Chief Engineer of the Consolidated Gas Company, Vice-President, and Columbus O'Donnel Lee, Secretary. Mr. De Goll is now in Germany looking after the company's interests. A considerable part of the company's stock is owned by Prof. Rowland's estate. Vice-President Hambleton says, in relation to the subject: "Prof. Rowland completed the invention in all its details. What remains to be done is to perfect its commercial shape. This is being done now. All that is needful to guide the company in its work is on record in Prof. Rowland's handwriting. We have a factory in this city where the machines are being made, but they are not as yet for sale. We have competent scientists engaged in the work, and they understand Prof. Rowland's principle thoroughly." The Western Union Telegraph Company is named as a possible purchaser, but that is at present doubtful.

MORE WIRELESS TELEGRAPHY.—The Northwestern Wireless Telephone & Telegraph Company, of which Joseph S. Schwab, 84 Lasalle Street, Chicago, is a chief stockholder, has sprung into existence from its parent company, the American Wireless Telegraph & Telephone Company. Articles of incorporation permitting the new company to operate in Illinois, Wisconsin, Iowa, Minnesota, in the northern part of Michigan and in Arizona were taken out last week at Phœnix, Ariz. The capital stock represented is $5,000,000. The parent company is said to have in successful operation a wireless line extending from Yokohama to Corea, a distance of 500 miles over land and water. It is also stated that the Cleveland and Buffalo steamship line has applied to Mr. Schwab for a line to connect Milwaukee and Grand Haven, to be in operation by June 4.

TELEPHONES FOR CUBA.—A. F. Blundell, manager of the telephone companies in Havana, has been visiting Chicago to buy 2500 telephones. He said: "Telephones there are in greater use than in any American city of the same size. People like to use them, and they have become a necessity. The warm climate and the habits of the people conspire to cause the Havanese to make constant use of the telephone. All that stands in the way of an immediate boom in Cuba is the Foraker resolution, which forbids grants and franchises from the provisional government. Capital in all lines of business is simply waiting."

TRACTION IN PARIS.—There is reported from Paris a fusion of the Paris Omnibus Company, the Thomson-Houston Electric Tramway Company and the Metropolitan Railway. It is proposed to reduce fares and abolish the vexatious "correspondence." If the deal goes through the trust will consolidate the transportation in the French capital. The scheme will require the approval of the municipal council, but the advantages offered are such as to render its consent probable. It is said that a big contract for equipment will go to the Compagnie Francaise Thomson-Houston, of which the head is Mr. Thurnauer, so well known in the United States. Nothing is known of the matter here.

THE GENERAL INCANDESCENT LAMP COMPANY, of Cleveland, has recently received orders for large shipments of lamps to England, Shanghai and Honolulu. During the month of April several thousand lamps were sold to the exhibitors at the Pan-American Exposition for use in illuminating the booths; also a great quantity of special sign lamps for use in electric signs erected at Buffalo and Niagara Falls. This company has also recently closed a contract with an electric sign manufacturer in New York City for 50,000 special sign lamps.

EDISON BATTERY FACTORY.—At the County Clerk's Office, Newark, N. J., papers of incorporation of the Edison Storage Battery Company were filed last week; capital, $1,000,000, the purpose of which is to manufacture the new lightweight storage battery recently perfected by Thomas A. Edison. Herman E. Dick, of Chicago; Walter F. Mallory and W. E. Gilmore, of Orange, N. J., are the incorporators. An immense plant is to be erected by the company at Glen Ridge, N. J., where the battery will be manufactured.

WORK IN NEW JERSEY.—The United Electric Company of Newark has just had a new switchboard built at a cost of $25,000, and has practically completed the work of putting all the electric light and power wires in the latest types of underground conduit. The Prudential Insurance Company of Newark has put a splendid equipment in its office building, the third largest of its kind in the world.

TELPHERAGE.—The United Telpherage Company, 20 Broad Street, New York City, has just made two new installations of its interesting and ingenious system for transporting material along wires by means of a "telpher" or traveling motor. One of these plants is outdoors, in the well known works of the Yale & Towne Manufacturing Company, Stamford, Conn. The other is in glass works at St. Louis.

BOILER CLEANERS.—The Ford Automatic Boiler Cleaner Company, Carleton Building, St. Louis, have just equipped the boilers of the Cumberland Electric Light & Power Company, Nashville, Tenn. They have also sold to the John O'Brien Boiler Works, St. Louis; E. Lilly, Indianapolis, and the Big Four Laundry Company, Columbus, Ohio. They are producing up to the limit of their present facilities.

THE MEXICAN SUGAR REFINING COMPANY, a concern recently organized with New York and New Orleans capital for the purpose of developing over 6000 acres of sugar land located on the Santa Fe estate on the Papaloapam River, in the State of Vera Cruz, Mexico, is to be equipped with an electric plant, which will be utilized for operating all the machinery, with the exception of the mills and crushers. J. B. & J. M. Cornell, of New York City, which firm have secured the contract for the entire sugar plant, valued at nearly $400,000, have just determined on awarding the orders for the electric installation. The Birmingham Foundry & Machine Company, of Birmingham, Ala., is to build two Corliss engines of 200-hp each. The Crocker-Wheeler Company will furnish the generators, consisting of four 100-kw machines. The same company will supply 15 motors, three of 50-hp, two of 30-hp, five of 10-hp, four of 7½-hp and one of 5-hp. These will be utilized for driving the pumps, centrifugals and other machinery, to which they will be direct-connected. The pumps, consisting of vacuum, juice, water and boiler equipments, are to be supplied by the Worthington branch of the International Pump Company. The water pumps, of which there are two, will each have a capacity of 1,250,000 gallons every twenty-four hours. The value of the Worthington contract is said to be about $12,500. The Crocker-Wheeler Company will also furnish 20 arc and 250 incandescent lamps for the lighting of the sugar factory, etc. The boilers, of which there are four of 250-hp each, are to be built by the Sterling Company, of Chicago. There will also be a fair-sized machine shop, which will be installed with a 10-hp engine and boiler, lathes, planers, drill presses, bolt cutters, pipe threading and blacksmith's tools, etc. Orders for these tools, etc., will be let within the next few days. The Cornell contract calls for the completion of the refinery and the entire plant by Feb. 1, 1902. The Mexican Company having options on neighboring property, it is anticipated that further contracts for equipment will be let in the near future.

TRAIN LIGHTING.—The description of the special car recently built for the use of King Edward VII. on his continental journeys, states that it is fitted with the Stone system of electric lighting. This system is one of the so-called "axle-light systems," whereby the power derived from the revolving car axle is utilized for driving the dynamo. Messrs. Vickers, Sons & Maxim, Limited, the great English firm, have arranged with the Consolidated Railway Electric Lighting & Equipment Company, of 100 Broadway, New York, to introduce their system of axle lighting in Great Britain and on the Continent. Satisfactory preliminary tests of this system have been made in England and Germany, and have attracted much attention abroad, and the great house of Vickers will soon be in a position to apply it on the railways of the United Kingdom and of the Continent. The superiority claimed for the American system is its mechanical excellence, and it may be expected that the electric light will displace gas, just as the gas displaced oil and candles by its manifest advantage, its established economy and the perfected efficiency which have been secured for it. Even far-away Japan has the new system under consideration, and measures are in progress to apply it to some of the railways of that country, which has already distinguished itself as among the most modern of nations in its persistent efforts to adopt the most complete and up-to-date methods.

THE MALTBY LUMBER COMPANY, of Bay City, Mich., recently suffered quite a loss in the fire at Detroit, which wiped out the pole yard of the Western Union Telegraph Company. They had some 15,000 poles stored there, and the Telegraph Company had nearly 100,000. The two together made by far the largest stock of poles in one place of any yards in the world. The destruction of this large amount of cedar poles will doubtless have a strong effect on the pole market, as the Telegraph Company has a large amount of construction work under way and will have to purchase at once. The Maltby Lumber Company have numerous other yards, notably at Pinconning, Saganing, and Boyne Falls, Mich., and the loss will not deter them to any large extent in making shipments. In fact, at the present writing, they are loading one of the largest capacity pole boats on the lakes a second time for shipment to the burned yard, and they have chartered her for three more trips. In addition, they are rushing forward all the cars possible, and will soon have as large a stock as ever, and better assorted, as the old stock had run short on a few sizes. The insurance will cover about half the cost of the poles.

ELECTRIC POWER SCHEME.—The Baltimore *Sun* says that a report comes from Philadelphia that a syndicate of Philadelphia and New York capitalists has arranged to acquire control of the project started by Baltimore to utilize the water power of the lower Susquehanna River in Maryland for the generation of electricity on a large scale, and its transmission to Baltimore, Wilmington, Chester and Philadelphia. It is said that this scheme is connected with a plan for a system of electric railways between New York and Washington, with branches to be operated in towns and cities within a distance of 20 or 30 miles from the main line.

AMERICAN APPARATUS IN GERMANY.—Mr. Frank H. Mason, U. S. Consul General at Berlin, in a report says: "So marked has been the German appreciation of American machinery and tools that the imports last year included 4757 tons of machine tools of American origin, against 588 tons from Great Britain and 388 tons from France. Besides this, there was imported from the United States during the same year 20,249 tons of agricultural machinery and implements, 343 tons of electrical machinery, 200 tons of steam engines, 574 tons of blowing machinery, and 331 tons of pumps.

THE HARRISBURG FOUNDRY & MACHINE WORKS have secured an order from the Galveston, Texas, Street Railway Company, calling for a tandem compound Harrisburg standard engine of 200 horse-power, to be direct connected to a 125-kw alternating-current generator, ordered at the same time from the General Electric Company. Two 90-hp Harrisburg standard engines are to be installed in the Wells Building, 18 Broadway, which plant is being replaced. The engines will be direct connected to two 60-kw generators of Fort Wayne make.

THE MORGAN ENGINEERING COMPANY, of Alliance, Ohio, recently received a contract calling for the shipment to Cuba of two electric traveling cranes of six-ton capacity each, which are to be utilized for handling sugar cane in the Banes plantation of the United Fruit Company, further particulars of the electric equipment of which plant appeared in our last issue. The cranes are to be operated by 25-hp motors, supplied by the General Electric Company.

RUSSIAN TRADE.—U. S. Consul General Holloway, of St. Petersburg, reports Russian direct imports from the United States in 1900 as follows: Copper, $342,475; iron and steel wares, $42,230; handicraft instruments, $15,450; machines and apparatus of iron, steel, etc., $229,690; parts of machines, $74,160. The additional figures of the indirect American importations into Russia through Germany, etc., are very difficult to obtain.

BABAMABA BREAD.—The following Associated Press item is interesting, to say the least: "Schenectady.—A representative of the Great American & Oriental Babamaba Bread Manufacturing Company, capital $25,000,000, was in the city yesterday contracting with the General Electric Company for machines to cost about $1,000,000.

FREDERICK PEARCE, New York City, has recently closed a large contract with the Government for wiring, tablet switchboards, etc., for the Immigration Department on Ellis Island, New York Harbor, where so many hundreds of thousands of our European cousins first set foot yearly on American soil. The order amounts to about $25,000.

ADOLPHO OLIVER, of Orizaba, State of Vera Cruz, Mexico, who is at present on a visit to the United States has placed a substantial order with Elmer G. Willyoung, of New York City, for Röntgen ray apparatus, etc. Mr. Oliver is purchasing a considerable lot of scientific instruments, etc., and can be found at the offices of Felipe G. Canton in the Columbia building, 29 Broadway.

JAPAN imported machinery and engines in 1899 to the value of 5,657,000 yen and in 1900 to the value of 8,964,000 yen. The yen is worth 49.8 cents. This shows a marked increase for the period. There was a gain of corresponding magnitude in other iron and steel imports.

STREET CAR BRAKES.—The Westinghouse Air Brake Company has purchased the Standard Air Brake Company. The terms are not given. The Westinghouse Company will enter into manufacturing air brakes for street and interurban railroads on an extensive scale.

CINCINNATI TRACTION CONTRACT.—The North American Construction Company of Chicago has received the contract for building and rebuilding about 34 miles for the Cincinnati Traction Company.

THE AMERICAN VITRIFIED CONDUIT COMPANY, of New York City, has been awarded a further contract for the supplying of 850,000 feet of conduit for the Charing Cross & Hampstead Underground road, London.

THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD COMPANY has alloted a contract to the Buckeye Engine Company for the furnishing of two 1800-hp Corliss compound engines for installation in its new shops at Berlin, Conn.

THE WILDWOOD STREET RAILWAY COMPANY, of Wildwood, N. J., has awarded a contract to the Buckeye Engine Company, of Salem, Ohio—New York office, Taylor building, 39-41 Cortlandt Street—for two 200-hp engines for installation in its plant.

THE LIDGERWOOD MANUFACTURING COMPANY, of New York City, has obtained an order, through the Flint-Eddy & American Trading Company, for an electric hoisting equipment to be utilized for mining purposes, in New South Wales, Australia.

Special Correspondence.

ENGLISH NOTES.

LONDON OFFICE, ELECTRICAL WORLD AND ENGINEER, May 18, 1901.

KEW OBSERVATORY AND TROLLEYS.—The service of the London United Tramways Company has at last been put into operation, and all difficulties between the company and the Kew Observatory authorities seem to have been settled. This system of tramways commences at the terminus of the Central London Railway at Shepherd's Bush and extends by various routes in a westerly direction, connecting up many of the important outlying towns forming now the suburbs of London. It is unnecessary to state that immediately upon the tramways being put into service that great crowds took advantage of them, and they have been in popular use ever since.

THE GENERAL ELECTRIC COMPANY, LIMITED, of London, recently acquired an extensive site of forty acres at Witton, near Birmingham, and is now making rapid progress with the erection of factory buildings for the manufacture of electrical machinery, particularly heavy generators, as it already has large factories at Manchester, Birmingham and elsewhere for its electrical supplies and fittings. The framework will be of steel, and the factory will be in every respect modern and up to date. It will include a machine shop 850 feet long by 140 feet wide, and a power station from which all the departments will be operated electrically. In order to accommodate the workmen, who will probably number 3000 by the time the buildings are completed, a supplementary piece of ground 60 acres in extent has been secured in the vicinity, on which will be erected a modern village.

MARCONI IN LONDON.—Mr. Marconi, on his return to England from the United States, lectured on syntonic, or "tuned" wireless telegraphy before a crowded meeting of the Society of Arts. He asserted that the days of "untuned" wireless signalling, by which messages sent from any transmitter could be recorded by any receiver, are numbered. In view of this it is interesting to learn from Mr. Marconi that the Admiralty are about to instal the "tuned" apparatus, which ensures secrecy, forthwith on his Majesty's ships which are already fitted with the Marconi apparatus. Secondly, the inventor announced that he had fitted up an automobile to which is attached wireless signalling apparatus, and from which communication can be maintained with a base while travelling about the country. A practical demonstration of this automobile will be made to the War Office shortly. The "tuned" appliance is also to be fitted on the Belgian cross-channel steamers.

A NEW SIEMENS FACTORY.—For some time Siemens Bros. & Company, Limited, of London, have been looking for a suitable place in which to establish a large and up-to-date factory for the manufacture of generators from small to the very largest sizes in order to allow them to keep pace with the growing demand. Their present facilities at Woolwich were altogether inadequate, and they have recently purchased the "Hough" site, consisting of about fifty acres of level land on the south side of the town of Stafford for the erection of their new electrical engineering work. The site is bounded on one side by the London & Northwestern Railway, from which sidings are to be constructed leading to all parts of the works. The principal buildings will be the machine shop and the erecting shop, which will be of large size. In addition, there will be a foundry, woodworking shops, smithy, etc. All of these will be of the most modern design, and will be equipped with all the necessary appliances, and will be arranged in the best way for the uninterrupted flow of the work through the factory. Building operations will most likely be commenced soon. Messrs. Hird and Dumas, two highly intelligent representatives of the company, visited your side recently and have come back with many pointers. They also propose, it is said, to buy part of their equipment in the States.

MIDLAND POWER TRANSMISSION.—The Midland Electric Corporation for Power Distribution, Limited, whose headquarters are at Wolverhampton, is making rapid progress with its works at Ocker Hill, near Tipton, in the center of the Black Country, and intends to supply power to a radius of about seven miles, although in certain directions the lines will extend eight or nine miles. The following towns are embraced in this territory, which is a very closely settled one, and is comprised almost entirely of manufacturing enterprises: Wednesbury, Bilston, Willenhall, Wednesfield, Heathtown, Tettenhall, Upper Penn, Sedgley, Kingswinford, Wardsley, Brierly Hill, Quarry Bank, Cradley Heath, Lye, Great Barr, Tipton, Coseley, Bentley, and a large number of other towns. The power house, which is approaching completion, is 180 feet long by 73 feet wide, and there are being installed in it at present a 3500-hp Yates & Thom engine which will be coupled direct to a Ferranti generator of that capacity. Two other engines of from 1300-hp to 1500-hp are being supplied by S. Z. de Ferranti, Limited, coupled to Ferranti generators, and all the switch gear in the station will be of the Ferranti type. Eight Babcock & Wilcox boilers are being erected, and a Hunt coal conveyor is being installed in connection with a coal storage of about 1000 tons. The chimney shaft is of steel, 9 feet 6 inches diameter at the top and 180 feet high. Current will be sold to power users at 3 cents per unit, though for lighting purposes its charge is intended to be 9 cents per unit. The generators will develop two-phase current at 8000 volts, which will be distributed by means of underground cables, manufactured by the British Insulated Wire Company, to five sub-stations at the following towns: Bilston, Wednesbury, Tipton, Brierly Hill and Old Hill. In these sub-stations the voltage is reduced to 3000 volts, at which pressure the current passes to street-box transformers, in which it is reduced to 200 volts, at which voltage it is supplied to consumers, still, however, of the two-phase alternating type. Rotary transformers will be installed if necessary for producing direct current for tramway purposes. All of the distributing system will be underground, the cables being of the British Insulated Wire paper insulated type, with two elliptical cores and one concentric strip, which is earthed, the largest cable being of 1000-kw capacity. The same type of cable is used for the 3000-volt distribution, and also for the 200-volt distribution, the sizes and amount of insulation varying according to the amount of current to be carried and the voltage. The telephone and pilot wires will also be underground. It is expected that about $2,500,000 will be spent on the installation before completion. J. Hardy McLean is the manager and engineer of the scheme, and it is expected that the power house will be in operation by August of this year.

General News.

THE TELEPHONE.

LITTLE ROCK, ARK.—Articles of incorporation of the State Telegraph & Telephone Company of Ashdown, Ark., were filed May 16. The capital stock is $50,000. The incorporators are William Freeman and Frank A. Locke, of Ashdown, and L. A. Byrne, of Texarkana.

SAN FRANCISCO, CALIF.—The Home Telephone Company has been incorporated, with Colusa, Calif., as the principal place of business. Directors: W. H. Buster, O. Robinson, J. Grover, E. Swinford and A. A. Thayer. Capital stock, $5,000; subscribed, $825.

GAINESVILLE, GA.—Long distance lines have been started to connect this city with a number of outside points. John Oliver, of the local lines, has the extensions in charge.

SPRINGFIELD, ILL.—The People's Telephone Company, of Chillicothe, has been incorporated, capital stock, $4,000, to operate a telephone system. Incorporators: B. F. Zinser, Howard L. Pettet and D. Kelly.

INDIANAPOLIS, IND.—Articles of incorporation have been filed by the Wakarusa Telephone Company, of Wakarusa, with a capital stock of $10,000.

LETT'S CORNER, IND.—The Lett's Corner Telephone Company has been incorporated with a capital of $6,750, and will operate telephone lines in Decatur and Bartholomew counties. The officers are: President, J. R. Swope; Secretary, J. G. Evans.

MITCHELL, IND.—The town board of this city has granted a franchise to the Hoosier Telephone Company, of Salem, for the erection of a modern telephone exchange. The board also granted Lewis W. Spencer, of Georgia, the right to build a connecting line with his Georgia and Huron system. This town will then have independent long-distance connection with the outside world.

HARTFORD CITY, IND.—The city council has revoked and rescinded the franchise of the Central Union Telephone Company, which has a long-distance station here and a service to several factories. The franchise held by the company was granted fifteen years ago, and at that time a local service was established. It was afterwards abandoned, and only the long-distance service remained. The company announced its intention to re-established a local service, in competition with the independent company which had invaded the field left vacant by the Central Company. Poles and wires already had been sidetracked here, but the council has taken away the company's authority.

SPRINGFIELD, MASS.—The linemen employed by the New England Telephone & Telegraph Company in the western district and by the United Electric Light Company struck on May 13 for higher wages and shorter hours.

DETROIT, MICH.—Articles of incorporation of the new People's Telephone Company, recently organized here, are ready to be filed at Lansing. The capital stock is $2,500,000, 70 per cent. owned by the Everett Moore syndicate, of Cleveland, and 30 per cent. owned in Detroit. The list of directors includes G. L. Palms, Henry Stephens, Alexander McPherson, J. C. Hutchins, Theodore D. Buhl, of Detroit, and Arthur Pack, of Pontiac, Mich. H. A. Everett and E. W. Moore, principal owners of the Detroit United Railway, are two of the Cleveland directors.

CRAIG, MO.—The Craig Telephone Company, with a capital stock of $1000, has been incorporated by F. K. Allen, E. J. Kellogg, W. S. Thompson and others.

ST. LOUIS, MO.—The St. Louis County Court last week increased the assessment of all the telegraph and telephone lines running through the county.

NEVADA, MO.—Work is being pushed on the new independent telephone system from Nevada to Virgil City and Stockton, including several other towns. The line will be extended at once south to connect with a number of mining camps.

CHARLOTTE, N. C.—The American Telephone & Telegraph Company will complete within a month a direct telephone connection between Charlotte and Atlanta, Ga.

CHARLOTTE, N. C.—At Raleigh, where three rival telephone companies are operating, extensive improvements are being projected. The Bell Company announces that it will erect a 180-mile long-distance line to Greensboro, N. C., and intermediate points. The Interstate Company contemplates several new long-distance lines. It has ordered a new switchboard of 1200-light line capacity.

ALBANY, N. Y.—The Batavia Home Telephone Company has been incorporated, with a capital of $160,000, to operate a telephone line in Genesee with Batavia as the central point. The directors are Samuel B. Rawson, Addison B. Lord, of Elyria, O.; Alfred R. Smith, of North Tonawanda, and George C. Frost, of Buffalo.

DAMASCUS, OHIO.—The Damascus Telephone Company will build an exchange at Garfield.

BATAVIA, OHIO.—The Clermont County Telephone Company is extending its lines to Brazier and Olive Branch.

MARION, OHIO.—The newly organized Marion County Telephone Company has applied for a franchise in this city.

GERMANTOWN, OHIO.—The Germantown Independent Telephone Company has asked the council for a 50-year franchise.

PAINESVILLE, OHIO.—The Painesville Telephone Company will erect a new exchange building. E. L. House is manager of the company.

JEWITT, OHIO.—The Harrison County Telephone Company has secured a franchise for a local exchange which is to be connected with the new exchange at Cadiz.

ZANESVILLE, OHIO.—Both the Zanesville Telephone & Telegraph Company and the Farmers' & Merchants' Telephone Company have applied for franchises at Dresden.

GARRETTSVILLE, OHIO.—The Garrettsville Independent Telephone Exchange Company will build a branch exchange at Windham. B. F. Hopkins is manager of the company.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company has recently installed 31 private branch exchanges for leading business concerns, and has orders for 14 others.

EATON, OHIO.—The two independent companies in this county which have recently engaged in a territorial war have agreed to submit their difficulties to an arbitration committee.

SPRINGFIELD, OHIO.—The Springfield Home Telephone Company has been incorporated with $300,000 by Cleveland, Columbus and local people. A franchise has been asked for.

ARCADIA, OHIO.—The Central Union Telephone Company has secured a franchise in this place. The Findlay Home Telephone Company has secured a franchise to build a line through the town.

MANSFIELD, OHIO.—Mr. E. C. Bickel, who has been acting as manager of the Mansfield Telephone Company, has been appointed manager of the Stark County Telephone Company's new exchange at Canton.

BELMONT, OHIO.—Business men of Colerain are organizing a local telephone company. The exchange will have connection throughout the county over the lines of the Belmont County Telephone Company.

CINCINNATI, OHIO.—The City & Suburban Telegraph Association of Cincinnati will instal in the county court house a branch telephone exchange with twenty-six instruments throughout the building. The rental is $1060 per year.

LONDON, OHIO.—The London Telephone Company of this place and the South Charleston Telephone Company, of South Charleston, have consolidated their interests. The new company will be known as the Madison-Clarke Telephone Company.

WESTON, OHIO.—Prominent farmers of this vicinity have organized the Weston Mutual Telephone Company to build a farmer's system throughout this and neighboring townships. I. B. Ballmer is president and T. W. Smith secretary of the company.

NELSONVILLE, OHIO.—Rev. Father Ross, of Gloucester, priest in charge of the congregation of that town, has purchased the telephone exchange here, and will doff his priestly robes for the less prosaic, but perhaps more profitable, business of running a telephone exchange. He has purchased the majority of stock, and has complete control of the plant.

AKRON, OHIO.—Mr. Fred G. Frese, who has been general manager of the Akron People's Telephone Company since it commenced business, and who has been largely responsible for its remarkable growth, has resigned to devote his entire attention to the interests of the Cleveland Construction Company. Mr. Frese is succeeded by Mr. W. F. Laubach, of Akron.

BELLEVUE, OHIO.—The Huron County Telephone Company now has in operation 600 telephones and 60 miles of toll lines. The company controls exchanges at Chicago Junction, Bellevue, Monroeville, Plymouth and New Washington. It has recently gained control of the Stotts toll line, which embraces 16 miles of toll line and operates from Broughtonville to several small adjoining towns.

MIDDLETOWN, OHIO.—The village council, after carrying to its third and final reading an ordinance granting to the newly organized Citizens' Telephone Company a 25-year franchise, reversed favor and allowed the measure to die. At the same meeting the council granted an extension of 25 years to the franchise of the Miami Telephone Company (Bell) in view of promises made by the company to improve its system and reduce local rates.

OTTAWA, ONT.—The Inverness & Victoria Telephone Company, of Nova Scotia, is about to extend its line from North Sydney to Port Hood, and other points in Cape Breton Island.

OTTAWA, ONT.—Mr. E. F. Clarke, M. P., of Toronto, Ont., has written the City Solicitor of Toronto advising that a suit be entered against the Bell Telephone Company without delay in order to fortify the city against the legislation which the company will again apply for next year. He says that it is absolutely imperative that the public mind be aroused on the telephone question, and that the validity of the claim in the Act of 1892, purporting to place the rates to be charged by the company under Government control, should be determined also.

PITTSBURG, PA.—Twelve years ago an agreement was made between the late C. L. Magee, who was then Fire Commissioner of Pittsburg, and the Central District & Printing Telephone Company that there should be eighteen free telephones placed in the engine houses of this city. The telephone company placed the instruments in the engine houses, but with the understanding that they were never to be replaced by any other free telephones. Owing to the recent negotiations between the city of Pittsburg and the Pittsburg & Allegheny Telephone Company, however, which allow the Pittsburg & Allegheny Company the right of free telephones, the Central District & Printing Company has notified the city officials that the eighteen free telephones that have been in use by the city for so many years will now be removed, and there is every indication that there will be some long drawn out differences between the city and the local Bell Telephone Company.

MILWAUKEE, WIS.—Articles of incorporation have been filed for the Kurtz National Telephone Company. The company will construct and operate telephone lines and manufacture telephones and electrical apparatus. The capital is $25,000. The incorporators are J. W. Murphy, J. M. Clarke and J. P. Schmidt.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—Among the California electric power plants that recently began the use of oil fuel are those of the Salinas City Light & Water Company and the municipality of Alameda. At the latter plant a saving of $13 per night is anticipated.

SAN FRANCISCO, CALIF.—The Consumers' Electric Light & Power Company was recently incorporated, with Redding, Calif., as the principal place of business. Directors: J. Fillins, J. P. Eaton, C. Jacobson, J. W. Potts, G. W. Bush, L. Moore and E. S. Watson. Capital stock, $15,000; subscribed, $1,900.

BONNINGTON FALLS, B. C.—The electric plant of the West Kootenay Power & Light Company, at Bonnington Falls, is to be greatly extended, a contract having been let for the machinery necessary to enlarge the plant to 12,000-hp.

AUGUSTA, GA.—A $250,000 electric light plant is announced for this city. The plant will be erected on the first level of the Augusta canal.

UNION, N. C.—It is stated by a member of the Union Cotton mills that the mill may be run by electricity, if the electric power gives satisfaction.

TRENTON, N. J.—The Suburban Lighting Company, of Jersey City, N. J., has been incorporated. Capital, $100,000. Incorporators: John I. Holly, William F. Williams and Frank B. Randolph.

NEWARK, N. J.—Electric lighting of the city by a plant owned by the city is being considered by the Board of Works. Newark's contract with the United Electric Company will not expire until September, 1903, but one or two of the members of the board of works already are engaged actively in planning for the building of a municipal plant to do the work now being done by the United Electric Company. A new organization, known as the Essex Electric Company, has applied to the board for permission to lay subways and string wires, preparatory to establishing a plant, and it is possible the city will purchase this new company's interests.

HALIFAX, N.S.—At the recent session of the Nova Scotia legislature, the following acts were passed and have become law in this province: An act to enable the town of Lunenburg to borrow money for water, electric light and sewerage purposes; the town of Annapolis Royal, to borrow money for electric light purposes; the town of Parrsboro', to borrow money to extend its electric light plant; also acts to incorporate the Bedford Electric Company; the Nova Scotia Electric Light Company, the Oxford Electric Company, the Mahone Bay Electric Light & Power Company; the Eastern Telephone Company, the Valley Telephone Company, and an act respecting the Chambers Electric Light & Power Company.

LANCASTER, OHIO.—The Electric Light Company of this place contemplates the inauguration of a fan service in this town.

COLUMBUS, OHIO.—The long, drawn-out litigation over the municipal electric light plant is probably ended. Judge Bigger has issued a peremptory writ of mandamus compelling the city to proceed with the erection of the municipal plant.

CLEVELAND, OHIO.—A Cleveland syndicate, headed by A. C. Hay, has secured an option on the gas and electric lighting plants at Elyria and Oberlin, Ohio, and proposes to combine the plants at a point between the two cities and to furnish light to the surrounding farming district.

NORTH AMHERST, OHIO.—J. C. and B. A. Kendeigh have made a proposition to the village council to erect a lighting plant and furnish 35 arc lights at $4,000 per year, extra lights furnished at $35 each. The village has voted favorably on a proposition to float bonds to the amount of $15,000 for the purpose of building a lighting plant.

PETERBORO, ONT.—The Hydraulic Power Company, of Peterboro, is about to build a dam and develop electric power which is to be supplied to the American Cereal Company and other industrial concerns in the vicinity.

OTTAWA, ONT.—Mr. Edgar Tripp, Canadian commercial agent in Trinidad, reports that Mr. Charles H. Cahan, the representative of the Canadian syndicate backed by Sir William Van Horne, has obtained the legislative authority necessary and has completed his arrangements for the purchase of the electric light and tramway companies of Port of Spain. The capital of the new company is stated to be $1,000,000, of which over $200,000 has been subscribed locally.

OTTAWA, ONT.—The stockholders of the Ottawa Electric Company, which suffered so severely by the disastrous fire in April of last year, have displayed the greatest courage in a further purchase of a new issue of stock of the company, to enable it to reconstruct its power houses and plant in a modern fashion. These, when completed in September next, will be unsurpassed on the continent. The new works will cost about $350,000. The company expends in salaries, wages, etc., in the city of Ottawa, over $120,000 annually, and to the civic treasury it contributes $4,000 a year in taxes. Upon completing the improvements, now under construction, the company will have expended $1,500,000 in the development of the electric lighting system in Ottawa. The Ottawa Electric Company has now in operation over 100,000 lamps of 16-cp each, a number which is more than double that of any other city of equal population on the North American continent and greater per capita, than that of any other city in the world to-day.

MONTREAL, QUE.—The Royal Electric Company's contract for lighting the streets of Montreal expires in December, 1903, and tenders are now being called for on a new contract. Specifications are now out, and tenders are to be in by June 15 next. The new steam plant which the Lachine Rapids Hydraulic Company will erect in connection with the city lighting contract will be of about 2500-hp.

RICHMOND, VA.—The Atlantic Light & Water Company has been chartered to establish sewerage, electric and gas light and water plants at Virginia Beach, Va. Thos. R. Heller is president. The minimum capital is $25,000.

THE ELECTRIC RAILWAY.

MOBILE, ALA.—The leading street car lines of Mobile have been purchased by Atlanta parties who, it is said, will thus control the principal lines of this city, Dr. A. W. Calhoun, Judge Henry B. Tompkins and others having closed a deal to the above effect.

SYDNEY, C. B.—An electric street railway will shortly be built here. At a meeting of the Cape Breton Electric Company sufficient capital was subscribed to ensure the building of the road within a year.

MARION, ILL.—The Coal City Electric Railway Company, of Marion, has been incorporated; capital, $100,000. Incorporators: P. M. Johnston, Frank P. Read and C. M. Atterbury.

GALESBURG, ILL.—The People's Traction Company, of Galesburg, has been incorporated; capital stock, $10,000. Incorporators: Frank W. Latimer, Lake W. Sanborn and Eugene B. Hardy.

INDIANAPOLIS, IND.—It is proposed to prohibit by ordinance the use of arc head lights on interurban cars in this city.

MUNCIE, IND.—The final transfer of the right-of-way for the trolley line running from this city north of Ft. Wayne took place at a meeting held here on May 17. F. G. Brownell, owner of the right of way, formally transferred to Messrs. Hexter, Scheuer & Lewenthal, Cleveland capitalists, and others, the road that he has been at work upon for years. A stock company with $1,500,000 is being formed. Three-quarters of a million dollars will be in the name of two Cleveland capitalists. Work of construction will begin soon.

HEMPSTEAD, L. I.—The Mineola, Hempstead & Freeport Traction Company has obtained a franchise to build a trolley road through the village to connect with the proposed line to Queens.

CONWAY, MASS.—The Conway electric street railway company voted to increase the capital stock $15,000.

BOSTON, MASS.—A syndicate has been formed among Boston capitalists to build an electric railway in Washington, between Seattle and Tacoma, a distance of thirty-three miles, the contract for which calls for all the details of construction of a first class steam railway. Lee, Higginson & Company, Kidder, Peabody & Company and Stone & Webster are members of the syndicate.

WESTMINSTER, MD.—Mr. Charles E. Fink, of Westminster, Md., and two others have been granted a franchise for the use of the streets of Littlestown, Pa., for an electric railway for 40 years. The property is to be exempt from taxation for 10 years.

ST. JOSEPH, MO.—A mortgage for $1,500,000 has been filed Tuesday by the Kansas City & St. Joseph Electric Railroad Company to cover bonds of that sum issued by the company which is building the electric line between St. Joseph and Kansas City.

TRENTON, N. J.—The Harvey Lake Miniature Electrical Railway & Light Company, Riverside, N. J., has been incorporated; capital, $100,000. Incorporators: Edward Schwabenaldn, Paul Morris and James Orr.

ALBANY, N. Y.—The Warren County Railway has received the approval of the State Board of Railroad Commissioners for an increase of its capital stock from $200,000 to $500,000 and for the issuance of a first mortgage for $600,000. The new capital will be put into new construction. The Warren County Railway is the line running from Glens Falls to Caldwell and Warrensburgh.

BUCYRUS, OHIO.—The Buckeye Traction Company proposes to build a line from Bucyrus to Norwalk.

DAYTON, OHIO.—The Dayton & Western Traction Company is securing right of way for an extension to Richmond, Ind.

MEDINA, OHIO.—The Medina County Commissioners have granted a 25 year franchise to the Northern Ohio Traction Company for its proposed line from Barberton to Wadsworth.

GALION, OHIO.—The Ohio Central Traction Company has decided to build a local line on several streets of this place, in connection with its line to be built from Crestline to Galion.

JEFFERSON, OHIO.—The Jefferson County Commissioners have granted a franchise to the Pennsylvania & Ohio Railway Company for an extension of its line from Conneaut to the State line.

NEW PHILADELPHIA, OHIO.—The Commissioners of Tuscarawas County have granted a franchise to the Canton-Akron Railway Company to extend its line to Canal Dover and New Philadelphia.

TIFFIN, OHIO.—Stockholders of the Tiffin & Southwestern Railway Company have organized, electing H. P. Price president. The capital stock of the company will be increased from $50,000 to $2,000,000.

CLEVELAND, OHIO.—The Columbus, Delaware & Marion Railway Company has been financed by the Western Reserve Trust Company of this city. Jay E. Latimer, of Cleveland, is in charge of the construction work.

CLEVELAND, OHIO.—The permanent organization of the Canton, Massillon & Akron Railway Company has been effected and the capital stock has been increased from $1,000 to $1,000,000. E. W. Moore has been elected president and C. F. Moore secretary.

DAYTON, OHIO.—The syndicate headed by A. E. Appleyard, of Boston, and H. A. Fisher, of this city, has purchased the Dayton, Lebanon & Cincinnati, a steam road running from this city to Lebanon. The new acquisition will be changed to electric power at once.

PORT CLINTON, OHIO.—The latest company to promote a line through Ottawa County is the Toledo & Port Clinton Interurban Railway, which proposes to build a line following the Lake Shore from Toledo to Port Clinton. G. W. Acker, C. Dedean, L. Galshall and W. B. Geroe are the promoters.

TOLEDO, OHIO.—The stockholders of the Toledo & Bryan Air Line Railway Company have elected officers as follows: Milton Taylor, president; J. C. Bonner, first vice-president; R. G. Kerlin, second vice-president; F. V. H. Collins, secretary; John Q. Adams, treasurer; William C. Brewer, general manager.

CLEVELAND, OHIO.—The G. C. Kuhlman Company, which has succeeded to the business of C. G. Kuhlman has elected officers as follows: Fayette Brown, president; T. P. Howell, vice-president; C. A. Ricks, secretary and treasurer, and G. C. Kuhlman, general manager. The company has decided on a building site at Collinwood. Work on a large plant will start at once.

CLEVELAND, OHIO.—The Everett-Moore syndicate, the Pomeroy Brothers, M. J. Mandelbaum & Co., and other prominent local capitalists have quietly succeeded in securing control of the Miami & Erie Canal & Transportation Company, which was recently financed by W. H. Lamprecht for $2,000,000. The franchise which was secured by T. M. Fordyce provides for the electric propulsion of canalboats, but there is nothing in the agreement to prevent the operation of cars on the tracks.

WEST SUPERIOR, WIS.—The West Superior Street Car Company is making active preparations for great improvements in its system. The extent of the work will require several hundred thousand dollars expenditure.

THE AUTOMOBILE.

THE OBSERVATION AUTOMOBILE COMPANY, of Washington, has been incorporated at Wilmington, Del., with a capital of $100,000.

MEMBERS OF CABINET IN AUTOMOBILE RIDE.—The California Automobile Club recently took the members of the cabinet on a tour of the principal points of interest in San Francisco.

AUTOMOBILE CLUB RUNS.—The board of governors of the Automobile Club of America has passed the following resolution: "That all future club runs shall be paced by a pacemaker, to be selected by the Runs and Tours Committee; that the pacemaker shall set a pace which shall not exceed the speed allowed by law; that should any pacemaker or his automobile become disabled he shall appoint the driver of a following automobile as pacemaker, and he in turn if his automobile becomes disabled shall appoint the driver of a following automobile as pacemaker, and so on. Any pacemaker appointed by the pacemaker selected by the Runs and Tours Committee, or by his successor, shall have the same authority as the pacemaker appointed by the committee; that the pacemaker shall be distinguished by means of a red band worn on his left arm; that should any member of the club pass the pacemaker he shall be suspended, and on a second offence he shall be expelled from the club.

LEGAL.

TELEPHONE RATES IN WASHINGTON.—The Court of Appeals of the District of Columbia has affirmed the constitutionality of the Act of Congress of 1898, reducing by about 40 per cent. telephone rates in the city of Washington, thus reversing the judgment of Justice Barnard of the Supreme Court of the District of Columbia. The telephone company refused to reduce its charges to the rates fixed by the act, alleging it unconstitutional for the reason that it interfered with chartered rights and the service could not be performed at the prices fixed. Justice Barnard held the act unconstitutional and the case was carried to the Court of Appeals, which has reversed that judgment and directed the granting of the injunctions. An appeal will probably be taken to the Supreme Court of the United States.

PERSONAL.

MR. C. L. ROSSITER, formerly president of the Brooklyn trolley system, has become president of a new $500,000 trust company in Brooklyn.

MR. C. DOMAR KOUBITZKI, representing the *Electricien* of Paris, is now in this country, and has been visiting the Pan-American Exhibition at Buffalo.

MR. ALFRED HARMSWORTH, of the London *Daily Mail,* has given $50,000 to the Royal Hospital for an electrical plant, enabling the electric light to be used as a cure for lupus.

MR. A. L. DICKINSON, M. A. Cam., chartered accountant and fellow of the Institute of Actuaries, has joined the firm of Price, Waterhouse & Co. and Jones, Cæsar & Co., accountants, of New York and Chicago.

POPE—RUSSELL.—The marriage is announced of Mr. F. J. Pope, son of the late Franklin L. Pope, to Miss Mary E. Russell, daughter of Mr. and Mrs. P. A. Russell, at the Great Barrington, Mass., Congregational Church, on June 12.

MR. JOHN CROSBY NEELY, of the Kellogg Switchboard & Supply Company, of Chicago, was a visitor at our New York office this week. He has been visiting some of the numerous Kellogg independent telephone exchanges.

MR. GEORGE GRAY WARD, of the Commercial Cable, and Mr. C. A. Schieren are among those who have been invited to represent the New York Chamber of Commerce at the dinner of the London Chamber of Commerce on June 5.

MR. C. T. YERKES.—It is said that Mr. Charles T. Yerkes has disposed of all his street and elevated railroad interests in Chicago, getting $8,000,000 cash for the securities. It is said the purchasing syndicate paid $125 a share for Union Loop.

MR. GASTON SENCIER is publishing in France a book on Electric Automobiles, with the assistance of Mr. A. Delasalle and a preface by the pioneer, Charles Jeantand. This ought to make a very interesting volume. It is issued by the Dunod firm.

MR. JAMES W. DUNBAR, superintendent of the New Albany, Ind., Electric Light Company, was re-elected secretary and treasurer of the Western Gas & Light Association, which held an annual session in Louisville recently. Mr. Dunbar has held the office since 1893.

MR. WILLIAM S. TURNER, who is well known in connection with electrical engineering in this country, is sailing for Auckland, New Zealand, to

represent J. G. White & Company, Limited. For that firm he is to construct an extensive street railway system in Auckland.

Mr. A. S. CLIFT, of the engineering staff of the Crocker-Wheeler Company, sailed for Europe on Saturday last by Cunarder for a vacation trip.

MR. S. G. DE COURSEY will, it is said, be president of the company consolidating the American Railways Company and Electric Company of America.

MR. T. A. EDISON and other residents of Orange, N. J., have been greatly annoyed by threats of kidnapping their children. The neighborhood is alert with watchers, however, and the villain who tries the Edison house itself will find it one of the warmest places that ever struck him.

MR. W. F. WARNER, the inventor and patentee of the Warner pole changer for ringing telephones, has perfected an electrical piano playing attachment. He has organized a company for its manufacture, which will commence operations about July 1. The factory will be located in Muncie, Ind.

MR. C. T. MALCOLMSON on his return from work as electrical engineer for the U. S. Commission at the Paris Exposition, has become chief engineer for the South Carolina Interstate and West Indian Exposition Company at Charleston, and is now hard at work there laying out plans, etc.

MR. MALCOLM W. FORD, secretary of the Automobile Club of America, has joined the editorial staff of the *Automobile Magazine*. As a trained journalist of great ability, and one of the foremost athletes in this country, Mr. Ford is a welcome and useful addition to any editorial staff.

DR. FLEISCHMANN, one of the chief engineers of the Union Elektricitaets Gesellschaft, of Berlin, is now visiting this country on a trip of study and inspection, including a stay at Schenectady. The Doctor is familiar with American work, having spent some two years here at an earlier period.

MR. A. G. WANIER, secretary and treasurer of the Barschall Impregnating Company, has been laid up for the past week or two with a severely sprained and broken ankle—Pott's fracture—and it is to be feared that some little time must elapse before he can again circulate freely among his many friends.

MR. CHARLES J. SEIBERT has resigned his position as contracting engineer for the Reno Inclined Elevator Company and sailed for Brazil to become engineer of the Empreza Ventiladores Electricos, a concern operating in Barra do Rio Negro. Mr. Seibert has many old friends in the Sprague and C & C companies who will wish him success in the great South American Republic.

MR. EVELYN E. PORTER, M. I. E. E., of the electrical firm of E. E. Porter & Company, Shanghai, China, passed through New York this week en route for England. He describes Chinese conditions as naturally depressed after the recent troubles, but hopes that China will be opened up now. If not mended, she must be ended, and either way there lies hope of improvement.

MR. F. E. DRAKE, the active and efficient Director of Electricity and Machinery for the United States at the Paris Exposition, has now become associated with the management of the Union Elektricitaets Gesellschaft of Germany, which may be spoken of as the German end of the General Electric Company, and is a very large and important manufacturing concern, one of the most progressive in Europe.

MR. E. H. COX, who for some years past has been with the De la Vergne Refrigerating Company and made a great success of their Hornsby-Ackroyd oil engine in this country, has now joined the forces of the Electric Vehicle Company, and will have charge of an important part of their gasoline automobile sales. He is well known among electrical men, and is expected by them to repeat earlier successes in his new field.

MISS ISABEL FARADAY, a kinswoman of the immortal Michael Faraday, has made over to the Browning Settlement a ten-roomed house in East Dulwich, to be known as the Michael Faraday Home, and to be used as a rest resort for the poor of that parish, in which the great physicist was born. Funds are needed for fitting, say $750 and $500 per year for maintenance. Subscriptions can be sent to the Warden, Robert Browning Settlement, Walworth, London, S. E.

MR. C. M. JARVIS, vice-president in charge of the operating department of the American Bridge Company, will withdraw from the United States Steel Corporation rather than go to Pittsburg. He prefers his New England home and environment at Berlin, Conn., where he scored his great success in steel construction, and he wants a rest. In an interview in the Berlin *News* he expresses his conviction that the fine plant he built up at East Berlin will long continue in operation.

CAPTAIN G. O. SQUIER writes to a friend from the U. S. cableship Burnside, in the Sulu Archipelago that they have laid practically all the cable they had on board, and that it is working very successfully. The last link connected up our "feudatory," the Sultan of Jolo. Time is furnished now from the observatory at Manila to all important points throughout the islands as far south as Jolo, and a press bulletin goes free daily to every garrison. The resultant unification is rapid and significant.

JOHNSON-STOCKLY.—Mr. Owen McMahon Johnson, of New York City, and Miss Mary Galt Stockly, were married in the Presbyterian Church at Lakewood, N. J., on May 23. The bride is the daughter of Mr. and Mrs. George W. Stockly, while the bridegroom, who is the author of "The Arrows of the Almighty," is a son of Robert Underwood Johnson, of the *Century Magazine*. The marriage ceremony was conducted by the Rev. C. H. McClellan, assisted by the Rev. C. P. Butler. Afterward a wedding breakfast was served at the Stockly residence. Mr. and Mrs. Johnson expect to sail for Europe in July. They will make their home for the next two years in Paris.

MESSRS. EDWARD BERGTHEIL and A. WILSON YOUNG, of London, England, were visitors at the National Electric Light Convention. These gentlemen are members of the firm of Bergtheil & Young, who represent the Bullock Electrical Manufacturing Company, H. W. Johns Manufacturing Company and several other manufacturers, in England. They have recently opened a new establishment in Manchester, where they intend to carry a full line of street railway and electric lighting supplies. They have done quite an extensive business in Europe with the Bullock teaser equipment, having put it in practically every important English newspaper plant. Messrs. Bergtheil & Young have been spending six weeks in America and return on the Lucania June 1.

MR. H. DE STEESE, for many years prominently connected with the electrical supply trade, has taken a position with the Morris Electric Company, of New York. Mr. De Steese will travel for it most of the time, the growing business of the firm necessitating keeping a man on the road permanently. For a year or more Mr. De Steese has been connected with a London firm, where he went after four years' employment in the Western Electric Company. His many friends in this country will be glad to learn that Mr. De Steese has decided to return to his former work, and the Morris Electric Company is to be congratulated on having secured the services of so able a man to promote its interests.

MR. T. H. MACK.—The New York Telephone Company loses a very valuable official in Mr. Thomas H. Mack, who has resigned his position as contract agent to avoid a complete breakdown in his health. He has been adding subscribers lately to the company's system at the rate of over 15,000 a year. Mr. Mack, who was formerly in the banking business in Boston, has been in New York for eight years and has made an excellent record for himself, as during that period the number of telephone subscribers in the city has been increased from 10,000 to over 60,000. At the time that Mr. Mack began this work the management of most telephone companies rather neglected any efforts to make friends of their customers, or to attract new business. In choosing Mr. Mack to carry out a different policy the New York Telephone Company made an excellent selection, as by his tactful methods and extreme courtesy he has made friends for his company in every direction. It may be hoped that he will not be lost to the telephone field.

PROFESSOR R. B. OWENS, of the electrical department of McGill University, Montreal, and Mr. J. B. Ingersoll, E. E., chief inspector of rolling stock for the Montreal electric street railway, have just completed some interesting experiments with a new roller bearing, the Wright roller bearing journal, designed for all kinds of vehicles, from railway coaches to vehicles for ordinary street traffic. Two street cars on a certain route in the city of Montreal were used, and the object was to show how much electric power could be saved by the new device when contrasted with the journals at present in use in the street railway cars. These cars are at present equipped with the standard journal bearing, and the journey of 10 6-10 miles, covered with a large number of street corner stops, consumed 15,000-kw, or 20.37-hp, while the Wright roller bearing journal consumed 10,120-kw, or 13.43-hp. The two cars were alike and were loaded to represent forty-two passengers. The testing instruments used were Thomson-Houston recording wattmeters.

EDUCATIONAL.

UNIVERSITY OF TENNESSEE.—The annual scientific number of the *University of Tennessee Record* is just out. The leading article is entitled, "Technical Education in the South," and was written by A. C. Lanier, of the class of 1900. Other articles are: "The Electrical Current in Chemical Analysis," by E. F. Kern, of the class of '97; "Polar Planimeter," by Prof. W. W. Carson; "Welding of Copper," by Prof. J. R. McColl; "Tests on a Thirty-Kilowatt Dynamo," by Prof. C. A. Perkins.

Trade Notes.

THE AMERICAN BRIDGE COMPANY will furnish the steel work for the Rogers Hotel to be erected at the corner of Seventh Avenue and Fifty-fifth Street, New York City.

THE ELECTRICAL APPLIANCE COMPANY, Chicago, has just published a book cataloging in a most complete manner its new hotel, telephone, intercommunicating telephone and annunciator systems.

THE BAYLIS COMPANY has removed its office and factory from 99 Cedar Street to 140 Washington Street, New York. In its new quarters the company has largely increased manufacturing facilities.

THE WILLIAMS ELECTRIC COMPANY, of Cleveland, Ohio, report largely increased sales for their new high-power, long-distance bridging telephones. They also report an increase in export sales.

THE PERU ELECTRIC MANUFACTURING COMPANY, of Peru, Ind., has just published a booklet entitled "Peru Mains and Branches," and "Reasons for Their Existence." This booklet is something new and novel. It is sent free.

THE HANDLAN-BUCK MANUFACTURING COMPANY has acquired all the assets of the M. M. Buck Manufacturing Company, of St. Louis, and will hereafter conduct the business in railway supplies formerly carried on by the old concern.

BANKRUPTED BY SICKNESS.—The Southern Electric Company, of Charlotte, N. C., has gone into voluntary bankruptcy. The long-continued illness of the president, J. J. Gormley, is the reason assigned for the failure.

JANDUS ENCLOSED ARC LAMPS.—The Jandus Electric Company, Cleveland, Ohio, has just issued a neat little pamphlet describing the Jandus enclosed arc lamp, and pointing out its advantages. The mechanism and the various styles of the lamp are illustrated.

NEW WORKS OPENED.—The Sawyer-Man Electric Company announces the opening of its new works in New York City at 510 to 530 West Twenty-third Street, where in future the greater part of its product will be manufactured. The principal office of the company will be at the works after June 1.

THE LANE & BODLEY COMPANY, of Cincinnati, have addressed a letter to engine exhibitors at the Pan-American asking them to co-operate in a movement for improving the physical conditions of the installation of steam engines in the "pit" of Machinery Hall. A change for the better is very much to be desired.

THE MONARCH ELECTRIC AND WIRE COMPANY, of 125-127 South Clinton Street, Chicago, is the concern formerly known as Samuel Mankowitz, manufacturers of the Monarch Brand of weatherproof wire, and dealers in electrical supplies and material. They are active and progressive and propose pushing the brand vigorously.

THE CENTRAL ELECTRICAL COMPANY, of Chicago, has issued a new price list and discount sheet, dated May 1, applying to its general catalogue.

These have been distributed to all its customers who are in possession of a general catalogue, and any who did not receive a copy should let the Central know in order that it may be traced.

UNITED STATES CARBON COMPANY, Cleveland, Ohio, of which Mr. N. D. Sayle is receiver, reports activity in business as usual. A number of prominent parties are taking a hand in its reorganization, as the patented processes are valuable, and the products have already won a very high reputation. The president, Mr. Norman McCarty, was in active attendance at the recent N. E. L. A. convention at Niagara Falls.

SELECTIVE SIGNAL TELEPHONES is the subject of the latest publication of the Sterling Electric Company of Lafayette, Indiana. It is an attractive four-leaf booklet describing the styles and uses of its four station non-interfering party line telephones. It reports that it is always behind on orders and is increasing its force as fast as possible.

THE BUCKEYE ELECTRIC COMPANY reports an excellent demand from electric street railways for its Buckeye railway lamp. The filament used is the cellulose type, manufactured from the raw material by the Buckeye Electric Company. Special care is taken in the selection of the railway filament as to wattage, voltage and candle power. The company carries these lamps in stock at its Chicago office, No. 1537 Monadnock Building.

"A STEP FORWARD."—In a neat brochure under the title, "A Step Forward," the Bullock Electric Manufacturing Company, Cincinnati, Ohio, announces the consolidation of its sales department with that of the Wagner Electric Manufacturing Company of St. Louis, Mo., and adds a few brief remarks concerning the two companies. As already announced in these columns, the newly consolidated departments are under the management of Mr. E. H. Abadie.

THE CROUSE HINDS ELECTRIC COMPANY, of Syracuse, N. Y., was recently in receipt of the following from the Pacific Coast Borax Company: The switchboard is now installed, and we consider it a very handsome piece of work. Assuring you that we appreciate the efforts that you and your New York agent have made to fill our requirements in your line, and that whenever we are in the market for goods handled by you, it will afford us pleasure to see you obtain the order, we are, etc."

MESSRS. E. M. VAN DUZEE, JR., & COMPANY, Fifth and Jackson Streets, St. Paul, Minn.—Minneapolis office 830 Guaranty Building—announce that they have recently completed arrangements with the Haines & Noyes Company, manufacturers of guaranteed telephone apparatus to represent it exclusively as its agent for the State of Minnesota. They inform us that they will be in a position to sell to the trade as well as to the consumer, and that the prices will be identical with those of the Haines & Noyes Company.

BORDEN & SELLECK COMPANY, Engineers, of Chicago, Ill., reports active business in its conveying machinery department. Orders are on hand from the C. Reiss Coal Company, Sheboygan, Wis., for conveyors, elevators, screens, car pullers, for equiping a dock recently destroyed by fire; from Breen Bros., Utica, N. Y., for coal conveyors, elevators, etc., for newly equipping their yard; from the Sheboygan Coal Company, Sheboygan, Wis., for coal handling machinery, conveyors, screens, etc., and from the Cook & Brown Lime Company, Oshkosh, Wis., for conveyors and screens.

FEEDER POLE LINE.—George F. Rohn, Milwaukee, Wis., has been awarded the contract for a feeder pole line for the new pumping station of the Wisconsin Central Railway Company's plant at Fond du Lac. The pole line is approximately 4500 feet long and the feeder will be No. 4/0 waterproof wire. The contract also covers extension of the power switch board and equipping the pumping stations with self-starting equipment for direct-connected motor pump equipment. Mr. Rohn has just completed installing a 1000-ft. 1,000,000 c. m. cable feeder for the A. F. Gallun & Sons' electric power plant in Milwaukee.

MULTI-SPEED MOTORS.—The Stow Manufacturing Company, Binghamton, N. Y., has issued a handsome pamphlet descriptive of its slow multi-speed motor. A number of excellent half-tone illustrations show different forms of this motor and also a cross-sectional view, from which the principles of its operations can be observed at a glance. As is well known, the variation in the speed of this motor is obtained by varying the strength of the field, which is done by varying the reluctance of the magnetic circuit. This change of reluctance is effected by changing the position of an adjustable plunger, which forms the core of the field magnet.

THE STURTEVANT COMPANY'S PLANT.—Some idea of the magnitude of the works of the B. F. Sturtevant Company, of Boston, can be gathered from the fact that the engine and electrical departments, covering over an acre of floor space, which were recently damaged by fire, represented only about one-quarter of the total floor area of the plant. It was therefore possible by a process of compression in the blower and heater departments to provide within these walls sufficient space to re-establish the damaged departments. This has now been done, the offices are again occupying their old quarters and work is progressing much as before the fire.

STORAGE BATTERIES IN RAILWAY WORK.—The value of a battery of chloride accumulators as a reserve power in case of emergency was forcibly illustrated on the evening of May 11, at Philadelphia during the severe electrical storm which visited the city at that time. A portion of the generating machinery at the Union Traction Company's Ogontz sub-station was disabled by lightning, and the battery station at Erie and Germantown Avenues carried this section of the load for almost a half hour, while connections with the Beach Street power house were being made. Without the battery this section of the road would have been forced to suspend operation for a considerable time.

FIBRE INSULATION.—The American Hard Fibre Company, of Newark, Del., is manufacturing an insulating material resembling hard or vulcanized fibre somewhat, but made by a different process. This material, called "insulite," is tough, hard, dense and strong and possesses high insulating qualities. It is made in thicknesses of one sixty-fourth of an inch and less. Its freedom from wrinkles and imperfections and its high insulating qualities render it particularly adapted for use in the winding of armatures as well as in lamp sockets and other electrical appliances where a thin reliable insulator is desired. The American Company manufactures, in addition, both hard and flexible fibre for electrical purposes.

ERICSSON TELEPHONE APPARATUS.—The Ericsson Telephone Company, 296 Broadway, New York City, has issued fac similes of a postal card from India inquiring as to its apparatus, bulletins, etc. It is also sending out a handsome quarto card embracing views of its two factories, one in Stockholm, Sweden, and one in St. Petersburg, Russia; the Copenhagen, Denmark, exchange, and the first portion of the switchboard installed at Shanghai, China, particularly interesting because of the Chinese operators shown. The switchboard in use there at the present time is only 600 numbers, but the ultimate capacity is 5000, and other sections are already on the way. Copies of this pretty card can be obtained on request.

THE AMERICAN ELECTRIC FUSE COMPANY, of New York, Chicago, and San Francisco, has removed its factory to Adrian, Mich., where larger and better facilities for turning out work are afforded. The company states that it is now employing over one hundred people, and the demand for its goods has been so unprecedented that it has been for some time considerably behind on its orders. The company has just made new arrangements, which will more than double its former capacity, for supplying porcelain, and has now on hand a large stock of its standard lines. There will, therefore, be no further delay in filling orders. It has recently closed contracts with several of the largest telephone companies of the United States for the furnishing of its standard lines of protectors, connectors, fuses, etc. The company is also doing a very large jobbing trade, as wholesalers, throughout the country. It expects very soon to place on the market an entire new line of illustrations and printed matter. This line, it is said, will be a distinct novelty.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, has recently taken the agency for the Lowatt incandescent lamp. It states that the success of this lamp has been instantaneous. This lamp has a complete metal reflector entirely within the bulb, directly behind a multi-coiled, carbon filament, both in proper relation to each other, and utilizing all the reflecting surfaces in a scientific manner. It is made in three different types, with concave reflector, convex reflector, or side reflector. This lamp is not to be confounded with lamps silvered on the outside of the bulb, the entire centre being entirely without reflecting power. The company states that an 8-cp Lowatt lamp, consuming 32 watts, gives a more effective light and will easily replace a 16 or 25-cp lamp consuming 60 to 90 watts, and in many instances a 32-cp consuming 110 watts. It claims that the Lowatt lamp in the concave type has a measured candle-power at the tip of from four to eight times its rated candle-power. Catalogues, descriptive matter and prices on the lamps will be mailed on application.

RUBEROID shows very conspicuously at the Pan-American Exposition, where it is used on the Government and other public buildings, both as a roofing and a flooring. At Paris the Standard Paint Company's exhibit was a novel one. It consisted of a building constructed entirely of Ruberoid, inside and outside, handsomely decorated. The walls, the ceilings, the roofs and the floors were all covered with Ruberoid. At the Pan-American the company has an equally neat exhibit. At the Omaha Exposition Ruberoid was used to cover the United States Government buildings and most of the other buildings there. It is adaptable to all climates, hot and cold. The barracks sheltering the United States and German troops in China are roofed with Ruberoid, which is also in use in the De Beers mines in South Africa. A large lot went to the Klondike fields in Alaska, a few months ago. Ruberoid is also largely used in Australia, Scandinavia, Russia, Germany, Spain, Austria, Italy, Egypt, West Indies, Philippine and Hawaiian Islands—in fact, in practically all parts of the world.

DE DION BOUTON MOTORETTE COMPANY, Brooklyn, N. Y., reports as follows: "The sale of Motorettes has far exceeded our most sanguine expectations. About one hundred Motorettes have been already delivered, and we are now turning out completed Motorettes at the rate of two a day, while we shall soon be enabled to do even better, owing to a further increase of our facilities, now in contemplation. One agent alone has sold thirty-five Motorettes, twenty of which are delivered to him, and in the hands of his customers. With the exception of the motors, which are imported from France, and the rough Motorette bodies, the entire vehicles are built by our own men in our own works. The business is at present so active that the works are in operation day and night. The plant includes machine shops, blacksmith and forge departments, a carpenter shop, brazing room, nickel-plating department and enameling, painting and unholstered departments, all of which are in full daily operation. Owing to the fact that so many Motorettes are in the hands of satisfied customers, and to our extensive advertising, the business is increasing very rapidly."

A NEW SPECIALTY COMPANY.—The International Specialty Company, of Adrian, Mich., has just begun business with the best facilities for turning out the highest grades for special work in wood and metal, both for electrical and mechanical purposes. The company does not manufacture any standard line of specialties, but is well prepared and equipped to fill any orders for a special kind of work. It believes this idea to be unique in the history of manufacturing. The company now employs over 200 people, who are engaged in the filling of orders for various kinds of special wood and metal work, its business ranges from the manufacture of all kinds of cabinet work, telephone work, tables, and furniture, to the making of all kinds of telephone parts, coils, stampings, formings, plating, screw machine work, etc. It claims to have the largest and best equipment in the United States devoted solely to this kind of business. The company especially solicits business in large quantities. It calls attention to its unequalled ability to turn out small box work. Correspondence may be addressed either to its Chicago sales office at 1000 Monadnock Block, of which Mr. G. Hallett Johnson is manager, or to the factory at Adrian, Mich.

CORRESPONDENCE INSTRUCTION.—The idea has been prevalent among the public that the system of education by correspondence was a more or less doubtful expedient, developed on money making rather than educational lines. As a matter of fact, this is far from being true, and more than one college president has come out in the most outspoken manner in praise of education by correspondence. It is stated that not only is correspondence teaching an effective substitute for regular school methods, but that in many cases it is far more efficacious, as a college course always presupposes a considerable amount

of training on the part of the student, and the correspondence system is developed with the understanding that the student who takes it up has had no preliminary training, while all unnecessary and theoretical technical matter is eliminated. Technical training is, therefore, brought within the scope of thousands of practical working men who could not hope to derive any benefit from the regular college courses, even if they could afford to attend such. Cornell University is stated to have over 15,000 students enrolled in her correspondence work in agriculture. Chicago University is heartily advocating correspondence methods, and the State University of Wisconsin has nearly 150 instructors devoted to the work of instruction by mail. Besides the older universities which are devoting a portion of their resources to correspondence instruction, a number of schools have, within the last few years, come to the front which are exclusively devoted to correspondence teaching. A conspicuous example is the American School of Correspondence in Boston, which is exclusively an engineering school. This school has already an enrollment greatly in excess of that of any of the residence colleges, although it has been founded within the last decade. Its instruction is intended solely for practical working men, who require a working knowledge of the mechanical sciences, and its success along these lines has been so marked as to place the system of engineering instruction by mail beyond challenge. This method of teaching has not only attained great importance in the educational world, but is undoubtedly destined to have a much greater advance in the future. Certainly no such opportunity has ever before come to the workingman to obtain a practical education along the special lines of his work.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED MAY 21, 1901.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 177 Times Bldg., N. Y.]

674,363. LIGHTING APPARATUS FOR VEHICLES; A. Brady, Galveston, Tex. App. filed July 26, 1900. A belt tension device.

674,398. PUSH BUTTON; S. Bower, Brooklyn, N. Y. App. filed Nov. 26, 1900. The button is loosely connected with the spring contact.

674,401. CAR LIGHTING; R. M. Dixon, East Orange, N. J. App. filed Nov. 20, 1900. The dynamo is driven by compressed air which is stored by means of a pump driven from the axle.

674,402. TELEPHONE SWITCHBOARD; H. A. Douglas, Grand Rapids, Mich. App. filed Nov. 2, 1898. Details.

674,427. APPARATUS FOR COLLECTING ATMOSPHERIC ELECTRICITY; A. Palencsar, Buda-Pesth, Austria-Hungary. App. filed July 10, 1900. An apparatus for collecting atmospheric electricity comprising a collecting body adapted to be kept in motion, heating means for said body, and a rheostatic machine and a converter connected with the said body electrically.

674,458. CLOSED CONDUIT SYSTEM OF ELECTRIC RAILWAYS; F. C. Esmond, Brooklyn, N. Y. App. filed Nov. 21, 1895. The collectors are mounted so that they can be thrown backward or forward mechanically a slight distance to prevent short-circuiting due to bridging the adjacent ends of sectional conductors.

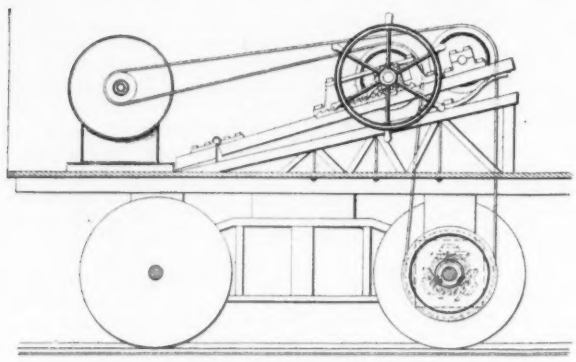
674,467. LINE CONDUCTOR FOR ELECTRIC RAILWAYS; A. Palmros, Fairmont, W. Va. App. filed Jan. 12, 1901. For low trolley wires sections are made removable to allow vehicles to pass on a cross road without interrupting the switches.

674,469. SYSTEM OF TYPEWRITING TELEGRAPHS; F. D. Pearne, Grand Island, Neb. App. filed Dec. 11, 1900. Details of the keyboard and switching mechanism.

674,501. STORAGE BATTERY; W. Gardiner, Chicago, Ill. App. filed Aug. 8, 1900. Details.

674,505. ARMATURE CORE; H. E. Heath, Windsor, Conn. App. filed Oct. 4, 1900. An armature core consisting of a frame, undercut ribs extending along the outer surface of the rim parallel with and adjustable toward and from the axis of the frame, means for adjusting the ribs radially of the frame, and annular sectional laminae fitting the rim of the frame and having mortises receiving the undercut ribs.

674,515. CALLING APPARATUS FOR PARTY TELEPHONE LINES; J. J. O'Connell, Chicago, Ill. App. filed Dec. 26, 1899. A condenser is provided at each subscriber's station in a grounded circuit or branch from the limb of the telephone line over which ringing current is directed, and relay mechanism is included in circuit with said condenser for closing a branch



674,363.—Lighting Apparatus for Vehicles.

circuit with which the call bell is associated, whereby the call bell may be operated by current in the circuit which is controlled by the switch contacts of the relay, thus securing the protection to the telephone line circuit which is afforded by the condensers at the subscribers' stations, while permitting the bell to be rung as freely as if the condenser were absent.

674,523. AUTOMATIC SIGNAL FOR ELECTRIC RAILWAYS; C. H. Storm, Waterloo, Iowa. App. filed Aug. 28, 1900. Details.

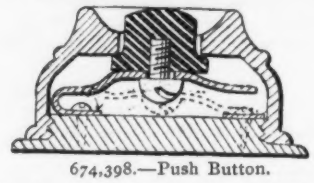
674,540. RELAY; F. D. Pearne, Grand Island, Neb. App. filed Dec. 11, 1900. The armature is held delicately poised above the actuating magnet, so that it will return to its normal position without the use of springs.

674,541. PROTECTOR FOR TELEPHONE OR TELEGRAPH INSTRUMENTS; J. Piel, Schoneberg, Germany. App. filed Nov. 2, 1900. A tell tale device to give notice when a circuit has been interrupted.

674,552. SELF-PLAYING MUSICAL INSTRUMENT; G. H. Davis, New York, N. Y. App. filed Nov. 30, 1897. The key of the piano is moved by causing a shoe to be carried into contact with a rotating drum, by an electro-magnet.

674,560. OUTLET BOX; H. Ill, Newark, N. J. App. filed Feb. 20, 1901. Details of a box in which the openings are closed by covering disks.

674,589. TROLLEY; J. Trickel, Reading, Pa. App. filed Nov. 10, 1900. Details.



674,398.—Push Button.

674,617. TROLLEY WIRE CLIP; J. W. Perry, Philadelphia, Pa. App. filed April 6, 1901. The clip is provided with thickened parts through which solder is poured to engage with the abutting surfaces of the wire and the clip.

674,642. ELECTRIC ARC LAMP; R. E. Ball, New York, N. Y. App. filed April 11, 1900. A prominent feature of this invention is a guide for the carbon rod consisting of a disk mounted to be freely tipped in any direction.

674,656. HANGER FOR TROLLEY WIRES; G. H. Ricke, Cincinnati, Ohio. App. filed Dec. 28, 1900. Details.

674,657. TROLLEY WIRE SUPPORTING AND CONNECTING DEVICE; G. H. Ricke, Cincinnati, Ohio. App. filed March 21, 1901. The wire is held in the loop of a U-shaped clip, the arms of which are prevented from spreading by a ring passing over them.

674,660. ELECTRIC SIGNALING DEVICE; C. F. Wilder, Chicago, Ill. App. filed Nov. 7, 1900. The signal is applied to draw bridges to give notice at a distance of the condition of the bridge.

674,670. WIRE COVERING MACHINE; E. Chamberlin, G. C. Murray, Brooklyn, N. Y. App. filed April 3, 1901. A machine adapted to remove the old covering, then scrape and polish the surface of the wire, and then recover it.

674,691. APPARATUS FOR THE PROTECTION OF CAUSTIC ALKALI AND HALOGEN GAS; C. E. Acker, Niagara Falls, N. Y. App. filed April 24, 1900. (See page 923.)

674,740. TROLLEY; A. Palmros, Columbus, Ohio. App. filed Oct. 6, 1899. A reversible frame each end of which carries an elongated roller for contact with the wire.

674,754. MANUFACTURE OF ELECTRIC GLOW LAMPS; F. Blau, Vienna, Austria. App. filed Jan. 2, 1901. The process of manufacturing self-regenerating incandescent lamps, which consists in permanently placing in the bulbs of said lamps a compound, which will evolve a carbon-containing gas or vapor.

674,770. ELECTRIC LAMP; C. B. Hull, Chicago, Ill. App. filed Jan. 30, 1901. A combined lamp and reflector adapted to be carried in the hand.

674,780. ELECTROLYTIC PROCESS OF PURIFYING CRUDE SPIRITS; J. H. Lavollay and G. E. Bourgoin, Paris, France. App. filed June 8, 1900. (See Current News and Notes.)

674,807. TELEPHONE SYSTEM; E. E. Yaxley, Chicago, Ill. App. filed Dec. 16, 1899. Details of construction whereby compactness of the multiple board is obtained.

674,825. APPARATUS FOR ACCUMULATING AND STORING ENERGY; A. De Castro, New York, N. Y. App. filed April 10, 1900. A fly wheel provided with polarizing coils; a source of electricity for exciting the fly-wheel; means for imparting rotary movement to said wheel; an armature encircling said wheel; and means for opening and closing the armature circuit, whereby the wheel is enabled to run free within the armature and without load during the operation of speeding it to a predetermined velocity, and is therefore caused to co-operate with the armature in the generation of an electric circuit.

674,840. CIRCUIT CONTROLLER; C. Hoffmann, Charlottenburg, Germany. App. filed March 10, 1900. A circuit controller is operated by a bellows in communication with the storage tank.

674,846. ELECTRIC TELEGRAPHY; O. J. Lodge, Liverpool, Eng. App. filed Dec. 20, 1897. (See page 931.)